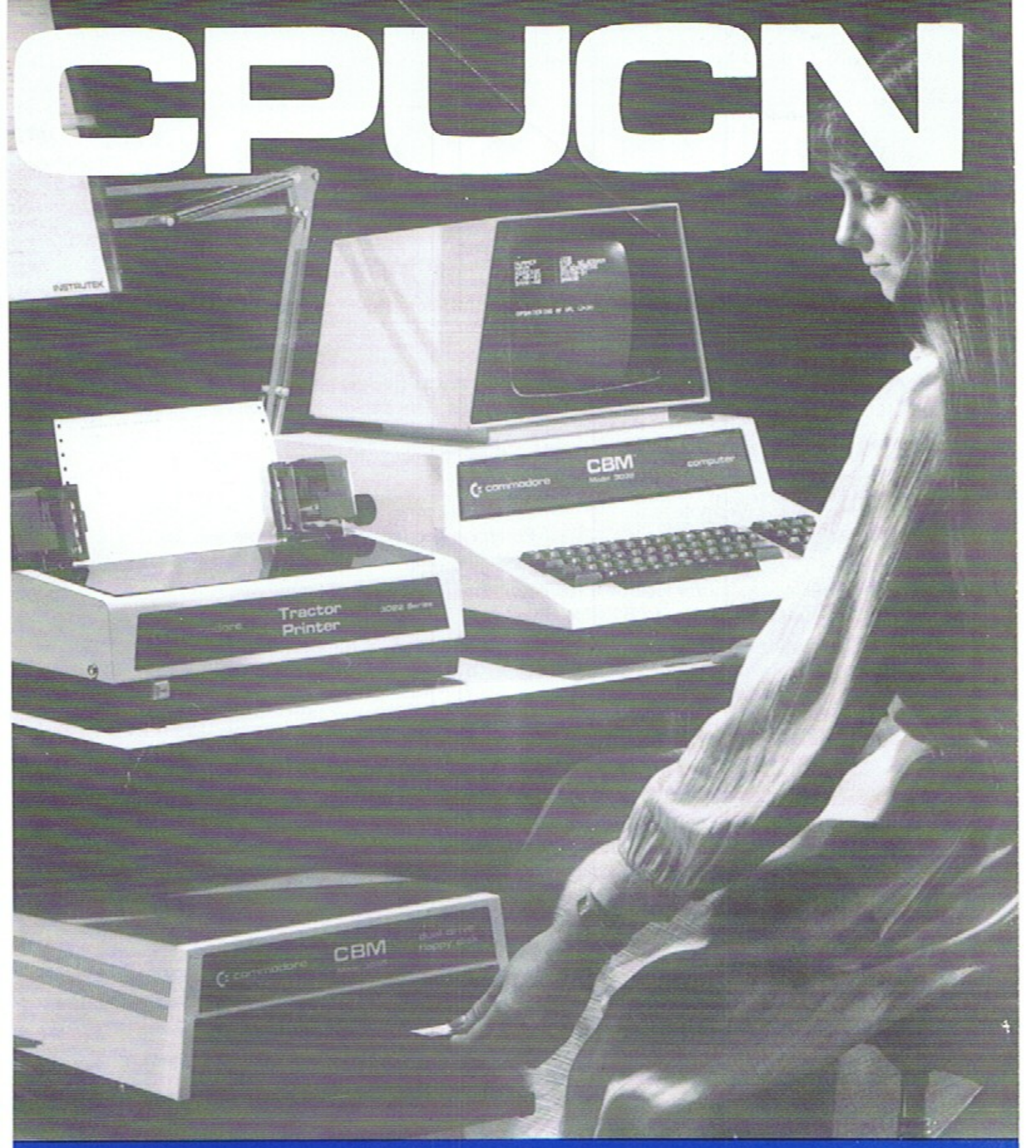
# CPUCN

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- Wordpro 4 Review
- Buying a Printer
- BASIC 4.0 ROM Entry Points
- Beginning Machine Code
- Graph Plotting Package

Volume 3
Issue 1

commodore

# COMMODORE NEWS

Andrew Goltz

## British Software goes International

In the first three weeks since the announcement of the Commodore Management System series of business software a great deal of enthusiasm has been generated by these packages - not least from overseas.

Commodore representatives from several of our international companies attended a special software exhibition held by Commodore UK on the 16th and 17th September at the Skyway Hotel. Our British dealers expressed considerable interest in the packages which provide both 40 column and 80 column PET Users with a foundation of good quality business packages. Our overseas guests were impressed at the speed at which Commodore UK's Software Department had co-ordinated development effort on programs for the 8000 series PETs.

As a consequence "OZZ - The Information Wizard" has already been announced by Commodore USA, and it is now expected that both "OZZ" and "Stock Controller" will be on sale in the USA within the next few weeks. Other Commodore Software Managers have also expressed interest in the "Commodore Management System", not only in English-speaking countries like Canada and Australia, but also in other parts of the world where the programs will be modified to interact with a user in his own native tongue. French and German "translations" can be expected soon.

## Me Too!

Not to be outdone by all this international dealing by Commodore UK, many Commodore Approved Products Suppliers used the occasion of the Skyway Software Exhibition to establish profitable overseas contracts. The top prize for business acumen must be handed to Paul Handover of Dataview. His popular Commodore Approved wordprocessing program "Wordcraft" so impressed Commodore International that they bought the overseas rights to "Wordcraft" lock, stock and print thimble. Consequently "Wordcraft", which will continue to be sold as "Commodore Approved" in the UK, will now be sold under the Commodore label in the rest of the world!

## Wordpro joins Approved list

As part of a more aggressive marketing plan "Wordpro" - for long a well-liked word processing program in Comodore's Business Software range, will now be sold directly by Professional Software as a Commodore Approved Product. This means that there will be two types of wordprocessing program, "Wordpro" and "Wordcraft" in the Commodore Approved Scheme. Both programs are high quality products with extensive wordprocessing features and comprehensive documentation. The difference lies in the way they tackle the problem of "user-interface", the way the edited text appears and is handled on PET's screen. There are advantages and disadvantages of both methods - and your choice will probably depend on your own taste as well as your intended application area. Ask your local dealer to demonstrate both programs and then choose the one that suits you best.

## In the Labs

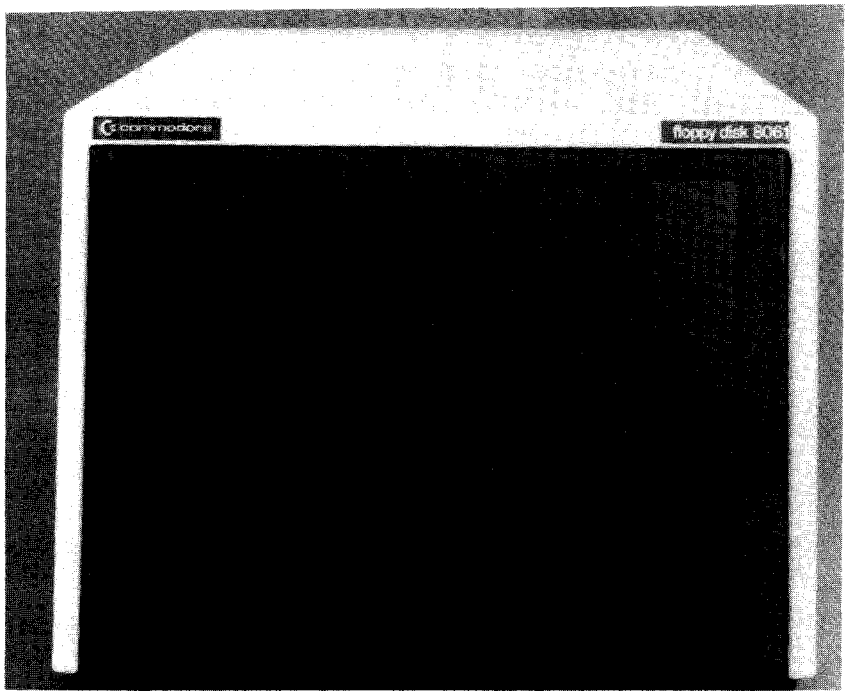
On September 30th, Commodore International announced a range of new products currently under development. Two products are of special significance for business applications.

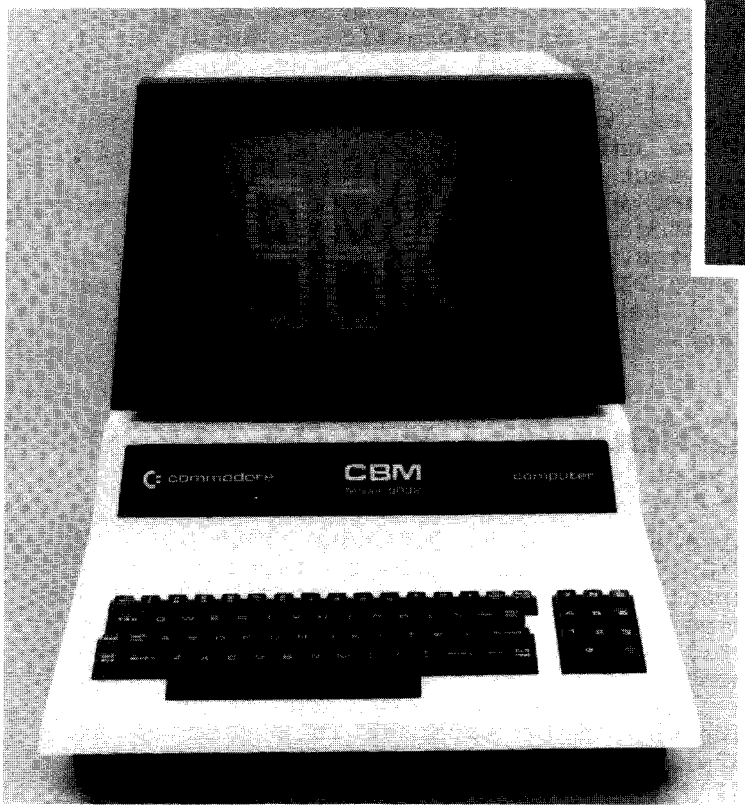
The first of these is the 8096, a new 80 column, 96K memory PET which will be accompanied by the 8060 series disk drives. The 8060 series is a range of 8" drive products which will include the 8061, which can handle up to 1.6 megabytes and the 8062 which has the ability to store and access up to 3.2 megabytes of information. Both units have two vertical disk drives, but differ in that the 8061 utilises single sided drives, whilst the 8062 has double sided drive units. Especially significant is the fact that data is stored in IBM 3740 format which will make it very easy to exchange data with mainframe installations. If all runs smoothly, the 8096 "SuperPET" and the 8060 series drives will be with UK dealers in late spring 1981.

## Colour PET will be called VIC

Also announced on September 30th was the VIC 20, a new colour machine aimed specifically at the education and home/hobbyist market. The machine utilises PET BASIC in ROM (making it a member of the PET family!) and comes with a full-sized keyboard and 5K of RAM (which can be expanded in stages up to 32k), colour, sound and high resolution graphics capability. VIC 20 will provide high quality colour pictures with an


commodore VIC 1001


commodore
floppy disk 8061

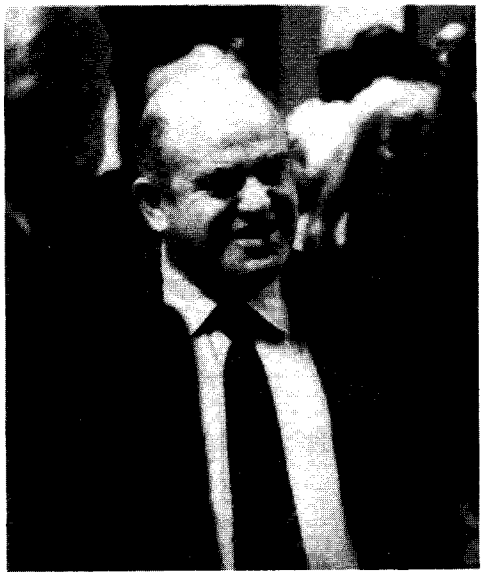

commodore
CBM
computer

ordinary colour domestic television set and utilises Commodore MOS Technology's latest Video Interface Chip to drive the composite video signal output. VIC 20, which is designed to be a user-friendly computer - "friendly in price, friendly in size, friendly to use and enjoy", is also expected to reach the UK in Spring 1981.

# Keep Commodore Dealers Sane!

On the page opposite you will find photographs of the VIC as well as the 8096 and 8061. We must however stress that these are development machines in an advanced laboratory prototype stage and they are NOT currently available. Please do not phone up your local dealer, or Commodore for that matter and ask when they will be available because nobody knows as yet. We will notify you via CPUCN as soon as the new hardware arrives in this coutry for retail.

# Skyway Software Exhibition
# 16th - 17th September



◀ Commodore's founder and Company President, Jack Tramiel.

(left to right) UK General Manager, Kit Spencer; Commodore's Chairman, Irving Gould and President Jack Tramiel. ▼


UK's answer to Jim Butterfield! Harry Broomhall ▼

Always on the alert for KGB men — Digital Design and Development, one of the many stands at the exhibition.

# REVIEWS

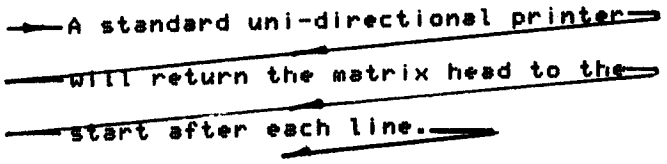
David Middleton

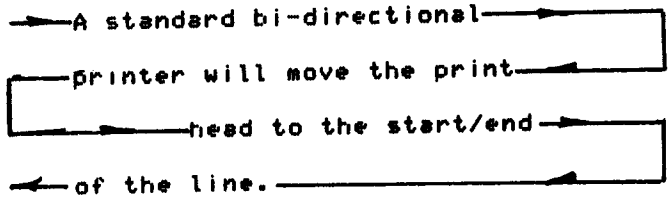
## A review of the 8024 Printer

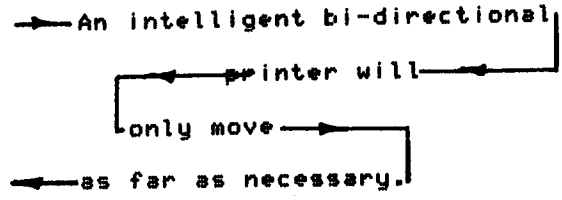
The Commodore 8024 fast matrix printer is intended to complement the 8000 series computer for applications where hard copy is required in large quantities. The printer is very good looking with a sound absorbent see through perspex cover.

The 8024 is an intelligent bi-directional printer. This gives higher throughput than a uni-directional printer which returns the matrix head to the beginning of the line after printing. It is also faster than a normal bi-directional printer which will send the matrix head to the end of the current line when it has finished printing. By being intelligent the printer will only move the matrix head to the end or start of the next line of text rather than the physical edge of the print region. This can give dramatic speed increases when printing in the middle of the page eg.

Example of output from 8024




The printer also outputs the £ sign!

The printer has a 9x7 dot matrix which gives it good print definition and also the ability to print descenders with letters such as:- gjqy. The standard 7x7 dot matrix printer is incapable of doing this which can lead to some text being very difficult to read.

The maximum line width is 132 characters with 10 characters/inch but the 8024 has movable tractor feeds allowing any of the common size papers to be used including labels.

The print speed is 160 characters/second at a sustained throughput which is far faster than most matrix printers available at present. A ribbon cartridge with an average life of 1 million characters makes ribbon changes both infrequent and also trouble free. Simply remove one and snap another into place.

There is an internal 132 character buffer which is filled before the line is printed. Characters can also be printed at double width for titles etc.

The 8024 has an internal bell which rings when the matrix head exceeds the edge of page sensors and also when the printer is about to run out of paper. The bell can also be made to ring under software control.

Up to 5 copies can be made simultaneously and there is a five position lever which allows the user to control the impact force of the matrix head.

The 8024 has switches for line feed and form feed. The paper can also be positioned by hand using a knob attached to the platen.

The printer responds to the same first 3 secondary addresses as used on the 3022/23 tractor printer so it is directly compatible with all current BASIC software using the 3022/23 printer under output format control but it will give the far faster speed and greater legibility which many businesses now require.

An innovation which will suprise most UK users is the provision for a pound sign. This is part of the character set in ROM and will replace the '#' symbol. This is an addition which many printers lack including the 3022/23 which normally has the pound sign as the user definable character. The 8024 has no user definable characters.

The Commodore 8024 costs £1160+VAT and will be available from your Commercial Systems dealer shortly.

## The 8050 1 Megabyte disk system

The 8050 disk is part of the 8000 series hardware and has been designed for use with the 8032 SuperPET. The disk system is based around the well tried 3040 operating system which has proved to be very reliable.

*Continued on Page 8*

# WordPro™
# Word Processing Software

Everyone expected it would happen sooner or later... with WordPro it already has! Now all the marvelous benefits of an advanced stand-alone wordprocessor are available with the WordPro series of software and the systems they create.

If you've already been shopping for software in the crowded wordprocessing marketplace, you've probably determined the features you really want. You'll find WordPro has them, and more.

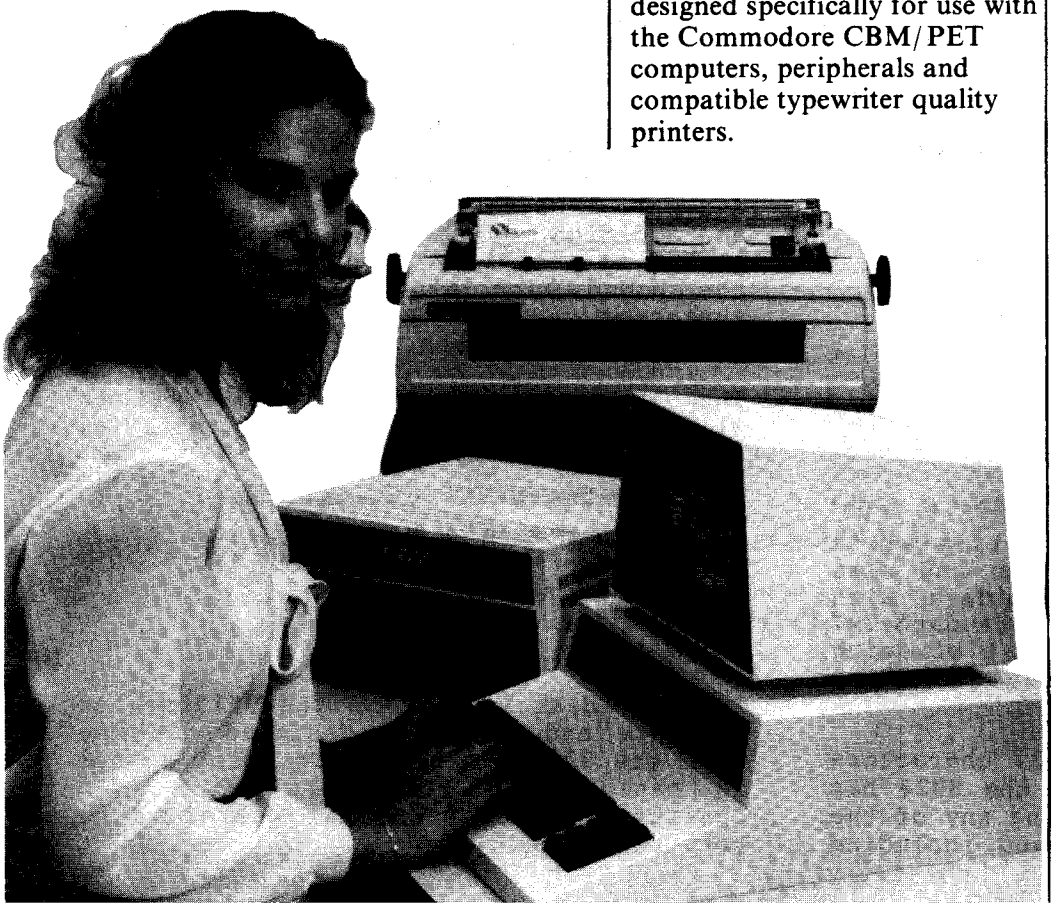
And if you haven't begun to shop yet, we urge you to compare, because only by comparison will you fully appreciate how complete and sophisticated WordPro software really is.

## WHAT MAKES WORDPRO THE BEST?

Our research has shown that while many wordprocessing packages have comparable features to WordPro, none can surpass Wordpro's EASE OF USE AND FLEXIBILITY. Wordpro operators need not be familiar with computer commands or functions. WordPro is easy to learn for anyone wtih ordinary typing skills.

## WORDPRO SOFTWARE IS LOADED WITH THE LATEST INNOVATIONS

Sophisticated systems programmed with leading edge wordprocessing features, WordPro is a series of programs designed specifically for use with the Commodore CBM/PET computers, peripherals and compatible typewriter quality printers.



## WORDPRO SOFTWARE HELPS CREATE YOUR OFFICE OF THE FUTURE

With WordPro you'll institute remarkable new efficiencies and time savings into your office procedures. Letters and documents can be quickly processed, free of errors and corrections. Edits and last minute changes are no longer a matter of annoyance and lengthy retyping sessions. The document is simply recalled from the memory, edited on the screen and reissued in crisp, finished form.

Using WordPro, work that used to consume hours now takes minutes. WordPro's easy editing capabilities and virtually unlimited filing capacity frees your staff from repetitive typing and tedious filing tasks. This enables them to devote their time to more productive and rewarding duties. They will find the whole business of wordprocessing an exciting task. And your company will see the benefit of that excitement paid off in increased enthusiasm and productivity.

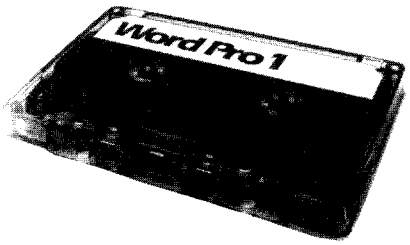
## WORDPRO GIVES YOU THREE LEVELS TO CHOOSE FROM

WordPro software is a family of programs designed specifically for Commodore CBM computers, disk drives and compatible hardware (i.e. typewriter quality printers).

# Turn your Commodore CBM/PET computer into a highly sophisticated word processing system


WordPro offers three levels of sophistication, from WordPro 1, which is a basic text editing system, to Wordpro 4, which brings you virtually every important feature offered by dedicated word processors. Each level of software is extremely easy to learn...and just as easy to operate! WordPro software brings you the very latest advances in high speed, efficient wordprocessing.

**WORDPRO 1** is ideal for hobbyists, students and organizations who can benefit from the advantages of a basic wordprocessor without the program refinements of a commercially oriented system. WordPro 1 is recommended for use with the CBM/PET 8/16K, C2N cassette and a properly interfaced printer.




**WORDPRO 3** converts the CBM/2001 32K computer into a highly sophisticated 40-column screen wordprocessor. This program incorporates the advanced features considered important to effective wordprocessing, including nearly every entering, editing, memory and printing feature available today. WordPro 3 is recommended for use with CBM/PET 32K (40-column) computer, CBM Dual Disk Drive, and a properly interfaced printer.

**AVAILABLE FROM YOUR LOCAL COMMODORE DEALER.** Join the hundreds of lawyers, educators, manufacturers, and businessmen who have already installed this remarkable software...and see for yourself.

**WORDPRO 4** has it all! With this program, you will have everything you could want from a wordprocessor...and then some. WordPro 4 includes every feature found on WordPro 3, but with the added advantage of an 80-column display screen. The 80-column display simplifies text editing and makes entering text in columnar formats effortless. And with a few simple keystrokes, you'll be able to visualize on the screen exactly how your document will look prior to printing it out. WordPro 4 is designed for use with the Commodore CBM 8032 computer, CBM Dual Disk Drives, and a properly interfaced printer.

## Phone or write Professional Software for the name of your nearest dealer

# Professional Software

**2nd Floor West End House**
**Hills Place**
**London W1**
**Telephone: 01-441 2397**

The outward appearance of the 8050 is nearly the same as the 3040 drive. Looking closer however it will be noticed that there is a small difference. The close down flap on the 3040 has been replaced with a different system. The disk is inserted into the drive and pushed until it clicks into place. The door is then pressed down. It will lock when fully depressed and the disk drive will auto-initialise. The disk is released by pressing the door down again slightly. To extract the disk from the drive the door is pushed in slightly.

The drives are made by Micropolis rather than Shugart as used in the 3040 and have two advantages. The first is the auto-initialisation mentioned above and the second is that the drive is self-aligning so there is no need to worry about the flap being left open for a few seconds to allow the disk to align as with the 3040.

A disk can theoretically hold an infinite amount of information but there are three limiting factors:-

1. The reliability of the disk. The floppy disk undergoes stringent tests to detect flaws in the magnetic surface. If the actual physical size of the recorded bit of information is large enough then there is litle chance of disk flaws causing any loss of information.

2. The size of the read/write head limits the spacing between tracks. There can of course be no overlap between the tracks or previously recorded information will be lost.

3. The accuracy with which the read/write head can be positioned. There is little point having a system which can place data onto the disk very densely if the head reads back the data from the wrong track!

The new Micropolis drive, which has been used in many other manufacturers' disk sytems has shown itself to be highly reliable. The read/write head is smaller and the drive which costs more than the Shugart has a greater accuracy. Point 1 is for the user to decide upon. With 500,000 bytes of data available purchase only the best quality disks.

The 8050 has some advanced features which only BASIC4 can access. The most useful of these is probably the relative record system which allows a very powerful random access data base to be set up without the user having to worry about which track and sector is being used, the relative record system takes care of all the housework. Another useful command is APPEND which will allow a sequential access file to be opened, data to be written to the end of the file and then closed without the file having to be read into PETs memory. The NEW command in DOS1 has been replaced by HEADER which includes a media check as the disk is formatted. BACKUP, which replaces DUPLICATE, is three times faster, giving a backup disk in only two and a half minutes. CATALOG will give the same DIRECTORY readout but it is not loaded in memory, very useful for just checking to see if a file is on a disk when programming, without losing the program.

It should be noted that a disk produced on the 8050 can not be read by the 3040 and vice-versa. DOS2 as used in the 8050 is available as a retrofit for the 3040 drive and designated DOS2.1. The amount of storage is not increased but it will mean that programs such as OZZ can be run without having to upgrade the whole system. DOS1 can read disks produced on a DOS2.1 3040 but should not be used to write to the disk as it will corrupt it.

The cost of the 8050 disk system is £895.00+VAT and the DOS2.1 retrofit is £38.00+VAT. BASIC4 retrofit for the 3000 series PET costs £38.00+VAT.

# Wordpro 4 — A review

WordPro is a program which will turn the PET into a powerful word processor. The program is designed to work on the 8000 series PET and is an ideal application for the 80 column screen allowing much more text to be displayed.

The keyboard of the 8000 series is much more suitable for the experienced typist, having a standard QWERTY layout and a full stop which is in the correct position at the lower right hand side of the keyboard, rather than being part of the numeric keypad. Cursor control and editing keys are grouped around the return key and the RUN/STOP key which was in the worst positon on the keyboard on the 3000 series has been moved out of the way to the top of the keyboard.

WordPro 4 is virtually the same as the now well established WordPro 1, 2 and 3 with a couple of extra functions which virtually double the effectiveness of the system. These will be discussed later.

WordPro works with two sections of memory, one is called Main Text and holds the body of the letter, contract or page while the other section of memory is called Extra Text and is used to hold names or addresses which can be fed into main text, this will give the capability for writing standard letters. Once it is set up WordPro will write the letters with very little assistance from the operator. The time saving that this can give an overworked secretary typing the same letter again and again with only a name and address to change is quite amazing. Extra Text is also useful for another function, for example, say 'Commodore Approved Product' is going to appear many times throughout the text then a short mnemonic is used as a key to the string. When the command append is given the user has to type in the mnemonic and then as soon as return is

pressed the words are taken from Extra Text and put at the current cursor position. A similar command allows whole pre-defined paragraphs to be taken from extra text and put into Main Text.

WordPro uses an 'in-text' command system whereby a tick at the start of the line is used to denote the start of a command sequence and depending on the command either a colon, a semi-colon or a carriage return is used to denote the end. The commands are all logical, for example 'lm' is 'left margin', 'lf' is 'line feed' and 'ju'is 'right justify'. The commands are all two characters long and followed by a number thus allowing margin settings, text centring and justification to be be altered at will.

WordPro 4 allows tabs to be set and cleared along the 80 column screen width allowing tables to be set out with considerable ease. As an aid to laying out tables a numeric mode is available which allows the cursor to be positoned at the right hand side of the column using TAB and then letting the user input the number, as the individual numbers are input the rest of number moves to the left rather than to the right as normal. This will give perfectly aligned columns of cash figures for example.

There are numerous editing features which give WordPro a power which is generally only found on much more expensive systems. There is a search and replace functiom which will look through the text either stored locally in memory or stored on disk and replaces it with another string. A hunt facility gives the user the optio of just finding a string. Once the word has been found WordPro drops into edit mode to allow the user to make any changes.

Whole words and sentences can be deleted and by setting a range it is possible to move, delete, copy or transfer groups of lines to other points in the text. This is extremely powerful for text which is being written directly into the computer or for modifying an existing letter.

Disk storage is simple and effective. Text can be recalled so that it is attached to the end of the current text, or replaces the current text depending on the position of the cursor. A different command allows text to be inserted into the middle of that already resident in memory. All or part of the text may be saved to disk and if a file name is given and it already exists on the disk the option of replacing the file is given.

The main addition which WordPro 4 has over its other versions is in the output mode. The finished document can be sent either to a the screen, the Commodore 3022 printer, a standard ASCII printer or to a Spinwriter. You will notice that this text is right justified but if you look you will also see that proportional spacing is being used. This gives a very high standard to the finished document as the text lacks the regular layout which is present with typewritten work. The Spinwriter gives the document a layout which can normally only be matched by typesetting. The disadvantage with using a Spinwriter or for that matter any printer is its output speed. WordPro 4 cures this by having an option which allows output to the screen of the PET. The document can then be read to see if the layout is correct.

Another addition which will prove to be useful is the pound sign. This is called up by redefining a key. For example, assume the '#' symbol is not going to be used. This will be printed to the PET screen but when it is sent to the printer it will cause the pound sign to be printed.

WordPro is very simple to get used to. Helen, Market Supports secretary mastered WordPro sufficiently well to be able to demonstrate its capabilities only three days after joining Commodore. There are a few minor criticisms which are more annoying than anything else. When reading the directory from disk the text in memory is erased. By switching into Extra Text 23 lines of the directory can be read, if there are more than 23 entries in the directory those at the end are omitted. A more serious complaint is in the splitting of words at the right hand end of the screen. It tends to be fairly difficult to read the text when the words get split and it can also lead to spelling mistakes and spaces being missed out.

In conclusion I would say that I have been using WordPro now for 3 months and have produced a great deal of text with it. The program turns the PET, especially the 8000 series into a very powerful word processor which anybody in business will find a use for, even if its only to write a standard begging letter to your bank manager asking for more money!

WordPro is a Commodore Approved Product and should be available through all Official Commodore Dealers. WordPro 3 for the 3000 series costs 275 pounds and WordPro 4 will cost 395 pounds.

Wordcraft 80, the other Commodore Approved Product wordprocessor will be reviewed in the next edition of CPUCN and a comparison made between the two.

# BUSINESS USERS COLUMN

## The Choice of a Printer


### Barry Miles,
### Financial Consultant,
### North London Polytechnic


At first glance it might be imagined that the choice of a printer is easy. However as we shall discover this is not the case.

For instance, we may find the print from a daisy-wheel printer very easy to read but our real need may be for a printer which outputs very quickly, the output from which is relatively easy to read, whilst not being beautiful to look at.

Firstly we must determine what we want to do and what the criteria are by which we should judge a printer.

Individual business users will place different weighting on various attributes but the following items will need consideration.

To whom is the output to go? If it is for internal use only the quality of the printed output is not of prime importance, provided that the document is readable. If your letters are your shop window, in that they are your primary means of contact with your customers, then you attatch far greater importance to their appearance than if you are producing invoices or statements.

Is speed of the essence or not?

If you have a large amount of printing to do, it will be false economy to have a relatively slow printer, just to save on capital outlay, when by doing so you tie up your entire computer system, thereby slowing down other important tasks and possibly keeping staff idle, who would otherwise be working productively for you.

Many readers will already have a printer and I suspect that in most cases it will be the Commodore tractor printer. There are many operations for which this machine is ideal. It is reasonably quick, legible and has the added advantage of being able to display the excellent graphics exactly as they appear on the screen. Some will say that in business applications graphics have no place but the use of boxes in particular will make sense of an otherwise almost incomprehensible array of information.

That said, the advantage of being able to print graphics is a minor one compared with the additional less-obvious one. In buying the Commodore computer system, you may well have been following the precept that it is sensible to restrict your choice of computer to one of the top-selling ones, thus ensuring that the manufacturer is likely to be around for a few years! Also knowing that the producers of the packaged programs, on which you are going to rely in order to obtain the maximum from your computer, will, in order to have the largest market for their wares, be likely to support only those machines which sell well.

Buying a popular machine ensures that you can look forward to being able to choose additional programs from a continuing array arriving from program designers. There is a considerable variety of printers on the market and sadly, standardisation has not taken place. Some programmers take this into account and their programs are designed to work with practically all printers; some will change programs to suit your printer, (for a fee) and some leave it to your dealer to modify the program. If the program is written in machine code, as many are, for reasons of enhanced speed, it is a far from trivial task to modify it to run satisfactorily on another machine. It follows that your safest bet is to buy a Commodore printer, since it will be fairly unlikely that a program designer would fail to support the manufacturer's printer.

Without getting too technical about this, the result of failing to adjust for a particular design of printer may be that everything is printed in double-spaced format, or that, worse still, the machine fails to carry out a line-feed operation every time a carriage return is executed, so that succeeding lines are printed on top of one another. This antic may be amusing when first encountered but is not recommended for continuing legibility.

You may find you need to print routine matters quickly but that you also have a need for good-looking, well-presented output. Your requirements may be best met by buying two machines: one the Commodore printer, the other a daisy-wheel.

For those not familiar with the term, a daisy-wheel printer is so called because the letters are arranged around the periphery of the wheel, like petals on a

# PASCAL PROGRAMMING

Rob Evans

Following on from the REVIEW of Pascal in the last newsletter this article about Pascal is divided into three sections. The first, 'who will use Pascal', outlines exactly who I think will benefit from Pascal. The second section, 'how to learn Pascal', attempts to explain how you approach the problem of learning Pascal rather than actually trying to teach any syntax. This is because once you accept the structure of Pascal actually learning the syntax is relatively simple. The last section simply aims to get you familiar with PET Pascal.

## Who Will Use Pascal?

There are many people who may consider using PET Pascal, including,the lecturer thinking of teaching Pascal to students; a writer for a software-house; or a hobbyist moving 'up market'. If you need reassurance of this look no further than the American Department of Defence (DOD) who are pouring oceans of money into developing ADA - a language which is based on Pascal!

The University lecturer thinking of teaching Pascal on the PET will no doubt be aware of the general advantages of teaching Pascal on a microprocessor over teaching Pascal (or any other language) on a mainframe-computer - which in a nutshell is 'user-friendliness'. As a student who has recently undergone both methods of learning a new language (ALGOL68 on a mainframe-computer and Pascal on the PET) I have no hesitation giving my vote everytime to the PET. We have sold 25 copies of Pascal to Strathclyde University who intend teaching Pascal to 250 first-years and more advanced features to computer science second-years. Strathcylde exhaustively tested Pascal before they invested so heavily in it and we regard their faith in PET Pascal as a tremendous compliment. Who knows they might even produce a 'Strathclyde Pascal', along the lines of 'Strathclyde BASIC'! Which as most of you will know is a training-kit comprising programs and manual. We have also had enquiries from UWIST, Cambridge University and Chichester College and I'm hoping my own University, Brunel, will use PET Pascal.

A software-house should weigh the advantages and disadvantages of Pascal to BASIC. Advantages are many and include the following:-

1. Programs which are easier to write and debug because they are split into modules.
2. Programs which are easier to maintain because Pascal is easier to understand than BASIC.
3. Structured data types allowing, for example, lists and records.
4. Quicker program execution time (about 2 or 3 times quicker in the general case).
5. Immense satisfaction from writing in a structured-language.
6. Finally the hope that the more professional programmer will be attracted by Pascal.

No doubt the list the could be greatly extended but I've listed what I consider the most important advantages. One disadvantage with Pascal vis-a-vis BASIC is that strings are not so well catered for and must be manipulated via arrays. Software-houses that write some routines in machine-code note that they can still enter these routines from within a Pascal program.

Turning to the hobbyist I admit 120 pounds may seem a lot to spend in one go, but this must be offset with the many hours of pleasure I hope you will receive and dare I say prestige associated with being a Pascal user. Incidentally for a new language this is not considered expensive, a view tacitly shared I'm sure by those reacting with a thoughtful nod, when we mentioned the price at recent exhibitions.

## How to Learn Pascal

Anyone who already knows a block-structured language such as ALGOL or CORAL will find Pascal a delightfully simple language to learn. It is very straight-forward and neat. Because of this those approaching block-structured languages for the first time could not have chosen a better language and should experience none of the frustrations associated with similar languages such as ALGOL68, which is extremely complex.

For those outside the educational environment who have decided to teach themselves Pascal be, open-minded in your approach. The reason I mention this is that when switching from BASIC to Pascal one enters a new and strange programming world, familiarity with which will be richly rewarded with better and more satisfying programs.

If you are to teach yourself Pascal then

you need look no further than the manual supplied with your copy of Pascal. In my opinion it sets a new high standard for manuals. It contains a chapter for beginners to Pascal and has 101 pages. Useful are the numerous example programs included where new features of the language are introduced. As supplementary reading I can personally recommend 'Pascal User Manual and Report' by Jensen and Wirth, published by Springer-Verlag, which costs £5.95. After an initial, hopefully painless, period familiarising yourself with the concepts of block-structured languages the transition from BASIC to Pascal programming should be quite smooth and I am confident that in the long run the rewards, both in terms of professionalism and satisfaction, far outstrip the initial effort.

As a final note on learning Pascal I would hope that the Training Department will offer a course in the near future, so watch out for announcements.

# Practical Experiences of Developing a Pascal

As an insight into program development I'll briefly explain the method I adopted developing a program to play a word game I know as Jotto or bulls-and-cows (with no bulls only cows!). The game is not unlike a word mastermind type game which uses words of 5 letters and the program knows 1926 words. I use a 1926x5 character array which indicates the size of array available in Pascal. After deciding the logic the program was divided into a main-logic section and a number of procedures. The main-logic therefore consists of Pascal statements and procedure calls. To facilitate communication between main-logic and procedures a common variable list was used. This list was created as a file (logically enough called variables!) and subsequently appended to the front of each individually compiled module i.e. main-logic and procedures. The appendage is achieved in one short line:

```
#filename
```

So if a variable changes in any way you only have to alter one set of variables and simply recompile each module.

To illustrate a Pascal program you might like to study the following Pascal source lines:-

```
10 program screenprint;
20 var i,j:integers;
30 begin
40   page;
50   for i:=0 to 24 do
60      for j:=0 to 39 do vdu(i,j,'*')
70 end.
```

The first thing to notice is the layout of the Pascal source lines. Not each line starts in the first column. All Pascal programs are written in this fashion to reflect the structure of the program and the above program may equally have been written (remember it's on a 40 column PET):-

```
10 program screenprint;var i,j:integer;b
egin page; for i:=0 to 24 do for j:=0 to
 20 39 do vdu(i,j,'*') end.
```

Let me explain. All lines of code starting in the same column will be executed the same number of times, and this number may be from 0 to infinity. To help you there are THREE types of loop in Pascal, one of these, the 'for' loop you will have used in BASIC. If lines of code starting in the same column (or blocks of code) are contained in other blocks then they will be repeated each time the higher block is repeated. So back to our example the 'begin' on line 30 and the 'end' on line 70 brackets our program block, all code within the 'begin' and 'end' is executed once. And reading from the top, 'page' is executed first, where 'page' is a handy Pascal function which clears the screen. Next, on line 50, we find the first 'for' loop and this is executed 25 times, however EACH time this loop is executed the subordinate 'for' loop is executed 40 times. The function 'vdu' writes the given character to the screen coordinate, so the first time it is executed '*' is written to the top left hand corner of the screen. The program therefore clears the screen and then fills the screen with '*' row at a time. Also you may have noticed that the two integer variables i and j had to be declared before use.

The advantage of compiling each module separately is that you can concentrate on logically independent and hopefully small sections of code at a time. These can be clean compiled before progressing to the next.

When a module is clean compiled Pascal produces a second file, of the same name, but with the suffix '.obj'. For example, a module called 'main' becomes 'main.obj'. This file, known as the object, contains the P-code for that module, and it is this P-code file that is subsequently interpreted at run time.

However before the program can be executed each constituent module must be clean compiled and the whole lot tied together by using the link command. The link command requires that you specify program name and constituent modules and outputs the modules as one big file which is thus labelled with the program name. This file is the one that is used when running the program.

By the way, to save typing effort store the link command as a file then simply recall this file and edit out the line number each time you execute a link. This is a good save as module-name's tend to be long and tedious to type. Also don't make link commands too long as they must

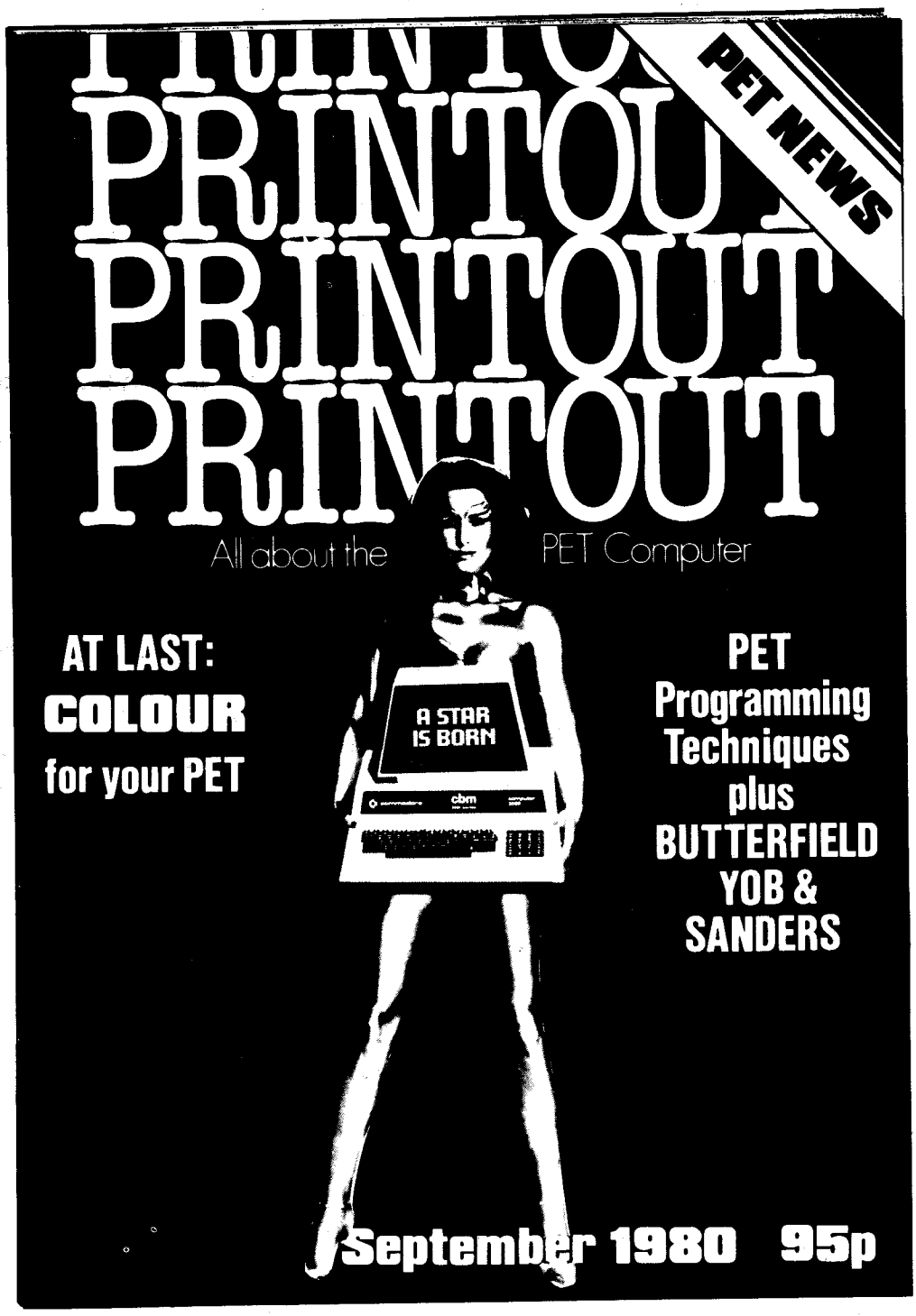
fit into 2 lines i.e. 80 columns. I made this mistake and found it a nuisance to recompile the modules with shorter names! Once the program has been successfully linked it can now be tested for logic errors i.e. debugged!

As a simple debugging aid displaying the procedure name upon entry into that procedure was extremely effective. This idea can be extended further by displaying pertinent variables at strategic places within procedures. Proceeding in this fashion bugs can be isolated to a particular module, which is amended, recompiled, and then relinked with the remaining modules before commencing the debugging procedure. For closer scrutiny of source code a printed listing can be obtained by setting a flag when compiling. Continuing in this fashion I found the program was developed reasonably quickly (You may even see the finished product if Commodore decide to release it!) and also with frequent interruptions working in a busy office I found the method of dividing the program into modules extremely effective allowing one to concentrate on small sections of code.

# Program User's Club

As I mentioned in the REVIEW of Pascal - see CPUCN vol. 2 no. 8 - we hope to be starting a Pascal User's Group, which would communicate via the CPUCN. Anyone interested in sharing their experiences of PET Pascal, whether they are programming tips or whatever should contact Dave Middleton at Commodore Slough.

# PET SOFTWARE
## — a guide

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# BASIC PROGRAMMING

## How to get started in computing — Strathclyde University comes to the home of computer novices . . .

A totally new concept of computer programming education, initially carried out as an experiment at Strathclyde University, will provide BASIC laboratory programming courses with 50 Commodore PET computers for up to 1,125 students each year.

With the release of STRATHCLYDE BASIC, the benefits of this successful experiment are now available in a Teach-Yourself BASIC Programming Course which brings University education standards and University levels of proficiency to the homes of all first time computer users and any educational establishment involved in teaching BASIC.

Whether this "free standing" course is attended at Strathclyde University or followed on the basis of self-tuition, the teaching tools for STRATHCLYDE BASIC are the same: pencil and paper, STRATHCLYDE BASIC (two cassette programs and one workbook) and the Commodore PET computer.

The course is presented in 23 working sessions. Detailed explanations and instructions are alternately followed in the exercise book, and with the insertion of the cassette program, displayed on the PET screen. This method provides the student with solid programming knowledge and the confidence to convert theoretical knowledge into practice on the computer. At the beginning of each session, the student is encouraged to get down to pencil and paper exercises. Then the PET computer takes the beginner step-by-step through the actual computer programming while displaying instructions and results on the screen.

Working to a given average or maximum time table (which takes into account reading and working with the PET computer), will ensure the certain amount of discipline necessary to achieve results. Designed for the newcomer to computing, if followed during regular periods of study, the course should not exceed 10 weeks, although it can be mastered in as little as five days.

Professor Andrew Collin, Head of the Computer Science Department at Strathclyde University and in charge of the initial experiment, is the author of STRATHCLYDE BASIC.

He explains the reasons for running an experimental "free standing" BASIC course at Strathclyde University: "Strathclyde University is a technological university and has one of the largest engineering schools in this country. For many years, our students have been taught programming in the traditional way. Whilst we were fully aware of the shortcomings of the conventional teaching methods, the introduction of interactive programming courses was an impractical project. The facilities provided came nowhere near to supporting the number of students involved. The cost of purchasing a terminal and connecting it to a central unit were not economically justifiable. With the introduction of Commodore's PET computer in 1978, our project of providing universal computer education for all students suddenly became feasible. After careful evaluation of several microcomputers we decided on the purchase of 30 Commodore PET computers... which we are now increasing to 50 units."

"The main objectives for our experiment were: Raising the standard of programming ability which the majority of the students can reach in a given time, whilst reducing the number of hours of personal involvement by the teaching staff."

"Over 170 students from different disciplines participated at this experiment of a "free standing" BASIC laboratory course. No formal lectures are held - it relies entirely on supervised self-tuition. Equipped with a workbook, containing some 23 units, students worked on time-tabled sessions and were able to test their newly acquired knowledge on any of the 30 PET computers available. The result was excellent. At the end of the course, over 94% of the students completed the test satisfactorily. Half of the remaining 6% who were prevented from taking the test by illness, have passed it on a later occasion. The failure rate of about 3% falls far below anything in our experience for first year classes and suggests that the new method of teaching is valid. We have had an enthusiastic response to the course and in some cases, students have actually expressed worries as to its academic value, because they find it 'fun'."

"Large scale programming courses can now

be held at a very low cost and assuming a life of 4 years for the 30 machines, two full time demonstrators or organizers, maintenance costs and interest on capital, the cost per student comes to approximately £15 per year, which even in today's difficult financial climate, becomes an economically viable project."

Professor Collin's advice to those wanting to achieve proficiency in BASIC by the end of his course is: "Be your own teacher. Don't jump to the next lesson unless you have fully understood and mastered the previous one".

STRATHCLYDE BASIC (cassettes and handbook) is available from Commodore dealers for £12.00

# Finding the Duration of a Key Press

## Robert Christmas

If a key is depressed while a program is running we can use its value in the program with GET A, but if GET A is executed a second time while the key is still held down it will return a 0 in A. If we wished to use the value of A to control, say, the frequency and duration of a musical note we would have to be able to detect how long the key is held down.

```
10 DEF FNK(X) = -(PEEK(515)=26)-2*(PEEK
   (515)=18)-3*(PEEK(515)=25)
```

or for New ROM PETs use the following:-

```
10 DEF FNK(X) = -(PEEK(151)=26)-2*(PEEK
   (151)=18)-3*(PEEK(151)=25)
```

will return a 0 unless keys 1, 2 or 3 are depressed. In those cases it will return 1, 2 or 3 for as long as the key is held down.

```
Test it with  20 PRINT "  "; FNK (0)
              30 GOTO 20
```

Clearly this definition of FNK is rather clumsy. It is used because it makes the operation of the function obvious. Using some logical operators it should be possible to detect all the numeric keys. Any suggestions?

If you wish to use the keys to control the program as above, but do not want to get a string of numbers printed when the program stops, then before the end of the program POKE the keyboard buffer pointer back to 0 with POKE525,0 (New ROM: POKE158,0).

# Super Basic

## David Simons

This utility adds an extra 24 commands to the normal BASIC. Great care must be used when they are in use, lack of care may result in the PET crashing. The commands are :-

@L -Loads screen from memory.
@S -Saves screen in memory.
@W -Swaps screen with memory.
@I -Inverts screen.
@D -Scrolls screen down a line.
@U -Scrolls screen up a line.
@H -Helps display text by displaying one screenful at a time, it then waits for an input. If you press space it will display another page of information and if the full-stop key is pressed it will return to "READY" mode. (note the full stop will be displayed.)

Also note that if you want the repeat key as well as the paginator you should enable the repeat key before enabling the paginator, it also must not be initialized if it is already enabled, to avoid any trouble you can type "@K:@H"

@F -Fills screen with a character.
@M -Swaps characters on screen.
@B -Draws a bar on a grid of 40 by 136, impossible ?? No, look at the graphics on the keyboard. This routine leaves room at the top for a title and room at the bottom for labels.
@C -Clears a bar made by above command.
@P -Makes a hard copy of the screen on the printer(inverse video will not come out).
@O -Sends a 2040/3040 command to disk.
@G -Loads a program from disk without the ",8".
@V -Verifies a program on the disk without the ",8".
@E -Exhibits a sequential file on the screen from the disk.
@N -Converts decimal to hex.
@T -Sends the PET to a place on screen for the next "print". It is advisable to send the cursor to home before usage of this command.
@GOTO -Computed goto allowing you to say go to a line which has a line number equal to the variable.
@AD -Defines a format.
@A@ -Prints string in a format (a bit like print using).
@R -Enables the repeat key.
@K -Disables the repeat key and the pagenator, this should be done before I/O activity (Eg LOAD & SAVE)
@J -Places the string that follows the 'J' on the screen, so that it is in the middle of the screen.

# Syntax and Usage of Commands

These commands can be used just like normal BASIC commands but if used after a "THEN" a colon should be placed straight after the "THEN".

The commands not listed below or on the next page do NOT need any parameters and may be used as listed above.

@G

Requires a string expression, this means you can use a string variable (containing the program name) after the 'G' or the name of the program in quotes ("). Eg-
@G "1:DEMO"
Would load demo off disk 1 so would this :-
A$="1:DEMO":@G A$

@V

Requires the same type of expression as "@G" but it will verify the program, (if the program is OK then it will return with "?SYNTAX ERROR" if it is not you will need to press [RUN/STOP] to return to BASIC.

@B

Must be followed with the column of the bar plot, a comma and the height of the bar.

@C

Must be followed with the column to be cleared.

@M

Must be followed with the old character, a comma and the new character.

@F

Must be followed with the PEEK/POKE character that is required.

@N

Should be followed by a number which is greater than or equal to 0 and less than or equal to 63999.

@GOTO

Exactly the same as "@N".

@E

Has to be followed by a string expression which includes the drive, the name and also the ",S,R". Eg:-

@E "1:APPLE,S,R"
Would display the file "apple".

@AD

Has to be followed by a string expression. With this command the '$' sign represents where the string that will be formated will go. Letters are allowed, the string MUST be followed with the @ sign

@A@

Must be followed by a string expression, which has to be followed by the @ sign (inside the string). Example of the 2 commands above.

```
10 @AD "TIME:HOURS $$:MINS $$:SECS $$@"
20 @A@ TI$+"@"
30 PRINT
40 GOTO 20
```

@O

Is to be followed with one of the disk commands enclosed in a string. The commands that may be used in the string are :-

| Command | abbreviation |
|---|---|
| SCRATCH | S |
| NEW | N |
| DUPLICATE | D |
| COPY | C |
| VALIDATE(*) | V |
| INITIALIZE | I |

(*) In older disk manuals this was called VERIFY but it has been changed since then.
Example of use.

@O "I1"
Would initialize drive one but so would :-
A$="I1":@O A$

@T

Has to be followed by the line to where the PET is to be sent, a comma and the column

@J

Has to be followed by a string and the last character of the string must be a @ sign.

@P

Though there are no parameters with this command it is perhaps wise to mention a few things. Inverse characters on the screen will not appear on the printer as inverse, as inverse characters don't look too good. You should poke 634 with 2 if you want standard print but if you want it to come out in double size (the top line won't) you should type poke634,1. Run stop will NOT work while this command is working.

# To Use the Commands

Simply type SYS 30529 enable and SYS 30513 to disable. The toolkit commands will work in most circumstances but sometimes the PET may jam.

On the 32k PET the commands start at $7700 and end at $7C00 and the screen is stored at $7C00 to $7F00. The first cassette buffer is used for string storage in the @P and @AD commands (note if you use the @P command after the @AD the format you defined will be lost). Odd places in the 2nd cassette buffer are also used, places used in 0 page include $00,$01,$02,$20,$21,$FF,$FEand $FD.

# Using the Basic Loader Program

Type it in as if it was a normal BASIC program, once you have typed it in save it-DON'T run it! Once you have saved it run it and type the number for arming it. Try a normal BASIC command and then work your way through the Super BASIC commands. If at any time the PET jams or behaves wrongly reset the machine, load Super BASIC and check the data statements (this will take quite some time !!). If you do not feel up to typing it in I will send you a machine code loader (loads Super BASIC into high memory in just 1 second) which is a much shorter program than the BASIC loader (that means it will load faster off tape/disk) on cassette for just 5 pounds. I will also send you a demo on the other side of the cassette.

David Simons
19 Reddings
Welwyn Garden City
Herts

```
0 POKE53,118:POKE52,255:POKE49,118:
  POKE48,255
1000 PRINT"■";:FORT=32768TO32807:POKET,
     102:POKET+960,102:NEXT
1010 FORT=32768TO33729STEP40:POKET,102:
     POKET-1,102:NEXT
1020 PRINT"■■■┌──────────┐":PRINT"■■■
     SUPER BASIC ":A$="■■■■■■■■■■■■■■■■
     ■■■"
1030 PRINT"■■■■■BY DAVID SIMONS.":
     PRINT"■■■└──────────┘"
1040 PRINT"■■■■■■■■USE ON NEW ROM":
     PRINT"■■■■┌──────────┐"
1050 PRINT"■■■■■32K PETS ONLY.":PRINT"■■■
     ■■└──────────┘"
1052 PRINT"■■■■■■■LOADING■":PRINTA$"____
     ____________"
1070 PRINTA$"■ TO ENABLE   SYS30529":
     PRINTA$"■ TO DISABLE  SYS30513"
1100 FORT=30464TO31743:READA:POKET,A:
     NEXT
1110 DATA201,78,208,3,76,240,123,201,84
     ,208,3,76,24,121,201,137,240,3
1120 DATA76,3,206,32,139,204,32,210,214
     ,32,176,199,76,118,0,165,1,208
1130 DATA1,96,76,42,121,208,3,76,240,12
     3,76,24,121,121,234,234,169,230
1140 DATA133,112,169,119,133,113,169,20
     8,133,114,96,169,76,133,112,169
1150 DATA78,133,113,169,119,133,114,96,
     76,193,123,234,234,234,160,0,177
1160 DATA119,201,64,240,3,76,118,0,230,
     119,208,2,230,120,177,119,230,119
1170 DATA208,2,230,120,201,85,208,3,76,
     121,120,201,68,208,3,76,79,120
1180 DATA201,70,208,3,76,30,120,201,83,
     208,3,76,182,119,201,76,208,3,76
1190 DATA214,119,201,87,208,3,76,246,11
     9,201,73,208,3,76,56,120,201,68
1200 DATA208,3,76,78,120,201,77,208,3,7
     6,160,120,201,65,208,3,76,199,120
1210 DATA76,60,121,24,162,128,160,0,132
     ,33,134,34,165,34,233,3,133,1,169
1220 DATA0,133,0,177,33,145,0,200,208,2
     49,232,224,132,208,232,96,24,162
1230 DATA128,160,0,132,33,134,34,165,34
     ,233,3,133,1,169,0,133,0,177,0
1240 DATA145,33,200,208,249,232,224,132
     ,208,232,96,24,162,128,160,0,132
1250 DATA33,134,34,165,34,233,3,133,1,1
     69,0,133,0,177,33,133,2,177,0,145
1260 DATA33,165,2,145,0,200,208,241,232
     ,224,132,208,224,96,32,117,214
1270 DATA134,0,160,0,132,32,162,128,165
     ,0,134,33,145,32,200,208,251,232
1280 DATA224,132,208,244,96,162,128,160
     ,0,132,1,134,2,177,1,73,128,145
1290 DATA1,200,208,247,232,224,132,208,
     240,96,160,40,132,34,160,0,132
1300 DATA32,160,191,162,131,134,33,134,
     35,177,32,145,34,136,192,255,208
1310 DATA247,202,224,127,208,238,160,39
     ,169,32,145,32,136,16,251,76,118
1320 DATA0,162,0,134,1,162,40,134,32,16
     2,128,134,2,134,33,160,0,177,32
1330 DATA145,1,200,208,249,232,224,132,
     208,238,169,32,162,40,157,199,131
1340 DATA202,208,250,96,32,117,214,134,
     1,32,204,214,134,0,160,0,132,32
1350 DATA162,128,165,0,134,33,177,32,19
     7,1,208,4,165,0,145,32,200,208
1360 DATA243,232,224,132,208,236,96,177
     ,119,230,119,208,2,230,120,201
1370 DATA64,240,23,32,253,244,134,1,133
     ,2,160,0,177,1,153,122,2,201,64
1380 DATA208,1,96,200,76,220,120,32,253
     ,244,134,218,132,219,160,0,185
1390 DATA122,2,201,64,208,1,96,201,36,2
     08,12,177,218,201,64,240,245,32
1400 DATA210,255,200,208,232,32,210,255
     ,200,198,218,208,2,198,219,76,243
1410 DATA120,169,0,133,196,169,128,133,
     197,32,117,214,134,1,32,204,214
1420 DATA134,198,198,1,24,165,196,105,4
     0,133,196,165,197,105,0,133,197
1430 DATA76,33,119,201,79,208,26,169,1,
     133,210,169,111,133,211,169,8,133
1440 DATA212,32,253,244,32,36,245,169,1
     ,133,210,32,172,242,96,201,82,208
1450 DATA54,169,103,133,144,169,121,76,
     247,122,165,151,201,255,240,10
1460 DATA197,255,240,9,133,255,169,16,1
     33,254,76,46,230,165,254,240,4
1470 DATA198,254,208,245,198,253,208,24
     1,169,4,133,253,169,0,133,151,169
1480 DATA2,133,168,208,227,201,75,208,9
     ,169,46,133,144,169,230,76,247
1490 DATA122,201,80,240,3,76,53,122,76,
     24,122,169,128,160,0,132,33,133
1500 DATA34,162,0,177,33,32,16,122,201,
     64,48,36,201,126,48,37,201,128
1510 DATA48,28,201,191,48,34,201,255,24
     0,35,157,123,2,232,224,40,240,32
1520 DATA200,208,220,230,34,165,34,201,
     132,208,212,96,105,64,76,206,121
1530 DATA105,128,76,206,121,233,64,76,2
     06,121,169,191,76,206,121,169,13
1540 DATA157,123,2,232,169,0,157,123,2,
     132,0,169,122,160,2,32,28,202,164
1550 DATA0,200,76,179,121,201,128,48,2,
     233,128,96,234,169,4,133,210,169
1560 DATA111,133,211,169,4,133,212,162,
     4,32,36,245,162,4,32,201,255,32
1570 DATA171,121,32,231,255,96,201,72,2
     08,21,165,144,141,82,122,165,145
1580 DATA141,83,122,169,122,133,145,169
     ,84,133,144,76,118,0,76,133,122
1590 DATA76,0,0,165,196,201,192,48,6,16
     5,197,201,131,16,3,76,81,122,173
1600 DATA18,232,201,191,240,12,201,255,
     240,245,169,147,32,210,255,76,81
1610 DATA122,169,230,133,145,169,46,133
     ,144,169,0,133,158,76,137,195,201
```

```
1620 DATA67,240,3,76,187,122,32,117,214
     ,169,128,133,1,169,39,134,2,229
1630 DATA2,105,79,133,0,169,32,145,0,24
     ,165,0,105,40,133,0,165,1,105,0
1640 DATA133,1,201,131,208,235,165,0,20
     1,32,48,229,76,118,0,201,74,240
1650 DATA3,76,2,123,32,253,244,134,0,13
     3,1,32,86,214,169,40,134,2,229
1660 DATA2,133,2,169,32,32,210,255,198,
     2,198,2,165,2,201,1,16,241,160
1670 DATA0,177,0,201,64,208,1,96,32,210
     ,255,230,0,208,2,230,1,208,236
1680 DATA133,145,133,145,169,16,133,253
     ,76,118,0,201,69,240,3,76,82,123
1690 DATA169,2,133,210,133,211,169,8,13
     3,212,32,253,244,234,32,36,245
1700 DATA162,2,133,210,32,198,255,160,2
     ,32,207,255,201,13,208,3,76,58
1710 DATA123,201,0,208,3,76,231,255,32,
     210,255,76,33,123,32,210,255,165
1720 DATA151,201,255,240,3,76,231,255,1
     65,152,208,252,165,150,201,64,208
1730 DATA209,240,241,201,71,240,7,201,8
     6,240,7,208,27,0,160,0,240,2,160
1740 DATA1,132,157,162,0,134,150,134,20
     9,134,211,32,253,244,169,8,133
1750 DATA212,76,201,243,201,66,240,3,76
     ,237,123,169,130,133,1,32,117,214
1760 DATA134,2,169,247,229,2,133,0,32,2
     04,214,134,32,165,32,201,8,48,23
1770 DATA233,8,133,32,169,160,145,0,24,
     165,0,233,39,133,0,165,1,233,0
1780 DATA133,1,208,227,170,189,185,123,
     145,0,76,118,0,96,100,111,121,98
1790 DATA248,247,227,160,142,58,3,186,1
     89,1,1,201,249,208,16,189,2,1,197
1800 DATA198,240,9,230,119,208,2,230,12
     0,76,84,119,174,58,3,230,119,208
1810 DATA2,230,120,76,118,0,133,145,76,
     118,0,76,0,119,32,139,204,32,210
1820 DATA214,32,117,231,152,32,117,231,
     208,230,229
```

## David Middleton

The version of Super BASIC shown here is obviously for the 32k PET BASIC2 machines but Dave has another version for a 16k PET BASIC2 so you will have to send him five pounds if you want to use the program, it is very good and some of the commands are very useful.

In CPUCN issue 2.8 David Pocock gave us a program which would give single key entry for the INPUT command. Not to be out done Dave Simons has sent me a program which will allow single key entry for any BASIC keyword, this will be published next time. Dave is also working on an article which will give details of how to interface new commands into the BASIC language. The technique is fairly simple but I have never seen it described before.

```
****************************************
   SOFTWARE PRIZE WINNER: DAVE SIMONS
****************************************
```

It can hardly be a suprise that Dave Simons wins the Software Prize for the best article in this issue of CPUCN. Dave will get £50 of Commodore Software from the Master Library. Do not forget that there is also the chance of a £250 software prize which will be announced at the end of the volume.

```
10 FORA=0TO39:@B A,2:NEXT:B=1
20 FORI=0TO(39/B)STEP1/B:@B I*B,10+3*B
   +4*B*SIN(I):NEXT:B=B+1:IFB>20THEN
   END
30 FORA=0TO39:@C A:NEXT:GOTO20
```

```
5 FORA=0TO39:@C A
10 FORA=0TO39:@B A,2:NEXT:B=1
20 FORI=0TO(39/B)STEP1/B:@B I*B,10+3*B
   +4*B*SIN(I)
25 NEXT:B=B+1:IFB>20GOTO5
30 FORA=0TO39:@C A:NEXT:GOTO20
```

```
1 B=1
5 FORA=0TO39:@C A
10 FORA=0TO39:@B A,0:NEXT
20 FORI=0TO(39/B)STEP1/B:GOSUB100:@B I
   *B,Y:@M 160,32
25 NEXT:B=B+1:IFB>15THEN1
30 FORA=0TO39:@C A:NEXT:GOTO10
100 Y=INT(4*B+4*B*SIN(I))
110 IFINT((Y+1)/8)=(Y+1)/8THENY=Y+1
120 RETURN
```

# A program to plot graphs

## David Middleton

The program I am about to describe does much more than simply plot graphs. It will take raw data from an experiment and give a double density plot of the results on scaled and labeled axes. The program was written for use in schools and colleges where an experiment is going to be peformed many times to different groups of students. The program may find applications outside schools because once the method for altering the program have been mastered it is fairly quick to set it up for other examples.

```
1 REM
2 REM
5 REM ***PROGRAMME FLOW CONTROLLER***
6 REM
7 REM
50 GOSUB9000: REM SET UP DATA ARRAYS
55 GOSUB6000: REM INPUT VARIABLES
60 GOSUB1000: REM INPUT DATA
70 GOSUB2000: REM CALCULATE POINTS
80 GOSUB4000: REM SCALE X-Y
90 GOSUB5000: REM SET UP AXIS AND PLOT
100 END
500 REM
510 REM
1000 REM ***  MAJOR INPUT MODULE  ***
1001 REM
1002 REM
1120 FOR CO=1 TO NI
1130 PRINTNA$(CO): FOR DC=1 TO ND:
     INPUTT(CO,DC): NEXTDC:
1140 PRINT:INPUT"IS THIS CORRECT Y/N
     Y";AN$:IFAN$="N"GOTO1130
1150 PRINT: NEXT CO:
1200 CL=1
1210 FORY=1TONI:T(Y,0)=T(Y,CL):NEXTY
1220 LO=T(1,CL):CO=CL:FORX=CLTOND
```

```
1230 IFT(1,X)<LOTHENLO=T(1,X):CO=X
1240 NEXTX
1250 IFCO=CLGOTO1270
1260 FORY=1TONI:T(Y,CL)=T(Y,CO):T(Y,CO)
     =T(Y,0):NEXTY
1270 CL=CL+1:IFCL<NDGOTO1210
1280 RETURN
1810 REM
1820 REM
2000 REM ****  CALCULATION MODULE  ***
2001 REM
2002 REM
2005 PRINT"■■CORRECTED MASS FLOW RATE M
     C, PRESS.RATIO P2/P1 & EFFICIENCY
     NT■"
2010 PRINT"  MC","  P2/P1",,"  NT":
     PRINT
2015 FOR CO=1 TO ND
2020 P=T(1,CO): S=T(2,CO): U=T(3,CO): V
     =T(4,CO): R=T(5,CO)
2025 Z=1-P/(13.6*H)
2030 W=(Z↑1.428)-(Z↑1.714)
2040 K=SQR(3.5*W)
2050 M=1.4113*K
2070 L=(U+H)/(H-S)
2090 G=(V+273)*((L↑0.2857)-1)/(R-V)
2100 PRINT M;L;G
2110 T(6,CO)=M:T(7,CO)=L:T(8,CO)=G
2120 PRINT
2130 NEXT CO
2135 PRINT"PRESS THE SPACE BAR TO CONTI
     NUE"
2140 GET A$:IF A$<>" "GOTO 2140
2150 RETURN
3000 REM
3002 REM
3005 REM ***    PLOTTING MODULE    ***
3006 REM
3007 REM
3200 FORCO=1TOND-1
3210 X1=T(XP,CO): X2=T(XP,CO+1): Y1=T(Y
     P,CO): Y2=T(YP,CO+1)
3235 IFX1-X2=0THENMG=1:GOTO3350
3240 MG=(Y1-Y2)/(X1-X2)
3250 CN=Y1-X1*MG
3253 IFX2>X1GOTO3290
3259 FORX3=X2TOX1STEP1:Y3=MG*X3+CN:
     GOSUB3900:NEXTX3:GOTO3400
3290 FORX3=X1TOX2STEP1:Y3=MG*X3+CN:
     GOSUB3900:NEXTX3:GOTO3400
3350 IFY1<Y2GOTO3370
3360 FORY3=Y2TOY1:X3=X1:GOSUB3900:NEXTY
     3:GOTO3400
3370 FORY3=Y1TOY2:X3=X1:GOSUB3900:NEXTY
     3
3400 NEXTCO:RETURN
3900 POKE179,Y3:POKE180,X3:SYS847:
     RETURN
4000 REM
4001 REM
4002 REM ***    SCALING MODULE    ***
4003 REM
4004 REM
4010 FOR DC=NI+1 TO NI+OD
4020 HI=T(DC,1): LO=T(DC,1): FOR CO=2
     TOND: IF T(DC,CO)>HI THEN HI=T(DC,
     CO)
4030 IF T(DC,CO)<LO THEN LO=T(DC,CO)
4040 NEXT CO
4050 IF MID$(GS$,DC-NI,1)="Y" GOTO4100
4060 SX=75/(HI-LO)
4070 FOR CO=1 TO ND: T(DC,CO)=INT((T(DC
     ,CO)-LO)*SX)+3: NEXT CO: GOTO4200
4100 SY=45/(HI-LO)
4110 FOR CO=1 TO ND: T(DC,CO)=INT((T(DC
     ,CO)-LO)*SY)+3 : NEXT CO
4200 SA(DC-NI,1)=HI: SA(DC-NI,2)=LO:
     NEXT DC: RETURN
5000 REM
5010 REM
5020 REM *** PLOT AXIS MODULE      ***
5030 REM
5040 REM
5050 PRINT"■WHEN THE GRAPH HAS BEEN PLO
     TTED PRESS   THE SPACE KEY TO CONT
     INUE"
5060 FOR CO=1 TO 1500: NEXT
5070 PRINT"■": FOR CO=1 TO 25: PRINT"┣"
     : NEXT
5080 PRINT"└┴┴┴┴┴┴┴┴┴┴┴┴┴┴┴┴┴┴┴┴┴┴┴┴┴┴
     ┴┴┴┴┴┴┴┴┴┴";
5100 PRINT"■": CO=20-LEN(PT$(1+GC))/2:
     GOSUB5900:PRINTPT$(1+GC)
5110 CO=8-LEN(PT$(2+GC))/2:GOSUB5950:
     FORCO=1TOLEN(PT$(2+GC))
5115 PRINTMID$(PT$(2+GC),CO,1):NEXT
5120 CO=23:GOSUB5950:CO=20-LEN(PT$(3+GC
     ))/2:GOSUB5900:PRINTPT$(3+GC);
5125 GOSUB7000
5130 PRINT"■";:VA=SA(YP-NI,1):GOSUB5800
     :PRINTVA$;
5135 CO=16:GOSUB5950:VA=SA(YP-NI,2):
     GOSUB5800:FORCO=1TOLEN(VA$)
5136 PRINTMID$(VA$,CO,1):NEXT
5140 CO=23:GOSUB5950:CO=3:GOSUB5900:VA
     =SA(XP-NI,2):GOSUB5800:PRINTVA$;
5150 CO=23:GOSUB5950:CO=30:GOSUB5900:VA
     =SA(XP-NI,1):GOSUB5800:PRINTVA$;
5200 PRINT"■":GOSUB3000:GC=GC+3:WAIT594
     10,4,4:IF GC<NG GOTO5000
5210 RETURN
5800 REM
5801 REM
5804 REM THIS SUBROUTINE MAKES EVERY
      NUMBER CORRESPOND TO THE FORM X.X
     XE XX
5805 IFVA=0THENVA$="0.0":GOTO5890
5810 VA$=STR$(VA*1.00000001E20): IF
     LEFT$(VA$,1)="-" GOTO5830
5820 VA$=RIGHT$(VA$,LEN(VA$)-1)
5830 CO=VAL(RIGHT$(VA$,2))-20
5832 VA$=LEFT$(VA$,LEN(VA$)-3)+RIGHT$(
     STR$(CO),2)
5850 IFLEFT$(VA$,1)="-"THENVA$=LEFT$(VA
     $,4)+RIGHT$(VA$,3):GOTO5890
5860 VA$=LEFT$(VA$,4)+RIGHT$(VA$,3)
5890 RETURN
5895 REM
5896 REM
5900 FORDC=1TOCO:PRINT"■";:NEXT:RETURN
5950 PRINT"■": FORDC=1TOCO:PRINT"■";:
     NEXT:RETURN
6000 REM
6002 REM
6003 REM ***   MINOR INPUT MODULE  ***
6005 REM
6025 REM
6040 INPUT"NUMBER OF SETS OF DATA■■■■■
     ■";ND: DIM T(NI+OD,ND), SA(OD,2)
6050 INPUT"ATMOSPHERIC PRESSURE MM OF H
     G";H
6100 RETURN
7000 REM
7001 REM
7002 REM ***   PLOT CONTROLLER   ***
7003 REM
7004 REM
7010 ONINT(GC/3+1)GOTO7100,7200,7300
7020 PRINT"ERROR IN PLOT CONTROLLER":
     STOP
7100 REM 1ST GRAPH
7105 XP=6
7110 YP=7
7120 RETURN
```

```
7200 REM 2ND GRAPH
7205 XP=6
7210 YP=8
7220 RETURN
7300 STOP
8590 RETURN
9000 REM
9002 REM
9005 REM ***       DATA MODULE       ***
9006 REM
9007 REM
9010 REM INITIALISE DATA FOR QUESTIONS
9015 REM
9020 READ NI: FOR CO=1 TO NI: READ NA$(
     CO) :NA$(CO)=NA$(CO)+CHR$(13):
     NEXT CO
9025 READCH$:IFCH$<>"END"THENPRINT"ERRO
     R IN DATA MODULE PLEASE CHECK":
     STOP
9030 DATA 5,PRESSURE DROP ACROSS NOZZLE
     (MM H20),INLET PRESSURE(MM HG)
9040 DATA OUTLET PRESSUE H2 (MM HG),INL
     ET TEMP TO1 (CENT.)
9050 DATA OUTLET TEMP TO2 (CENT.),END
9060 REM
9070 REM
9100 REM GRAPH TITLES
9110 REM READ FROM DATA IN THE FORM MAI
     NTITLE, X AXIS TITLE, Y AXIS TITLE

9120 READ NG: NG=NG*3: DIM PT$(NG):FOR
     CO=1 TO NG: READPT$(CO):NEXT
9130 READCH$: IFCH$<>"END"THENPRINT"ERR
     OR IN DATA MODULE PLEASE CHECK":
     STOP
9140 DATA 2,MASS FLOW / PRESSURE,PRESSU
     RE,MASS FLOW
9160 DATA MASS FLOW / EFFICIENCY,EFFICI
     ENCY,MASS FLOW,END
9170 REM
9180 REM
9220 REM NUMBER OF SETS OF OUTPUT DATA
9230 OD=3
9240 REM
9250 REM
9320 REM GRAPH SCALE VARAIBLE
9330 GS$="XYY"
9340 REM
9900 REM
9905 REM THIS COMES LAST AS IT IS ONLY
      USED ONCE WHEN THE PROGRAMME IS L
     OADED
9910 REM TO  SET  UP MACHINE CODE PLOT
               ROUTINE.
9920 IFPEEK(826)=200GOTO9960
9930 LO=846
9940 LO=LO+1: READ PO: IF PO=999 GOTO99
     60
9950 POKE LO,PO: GOTO9940
9960 LO=847: POKE826,200: RETURN
9970 REM
9980 REM DATA FOR M/C PLOT ROUTINE
9990 REM
10000 DATA165,180,74,133,178,144,5,169,
      3,76,93,3,169,12,133,181,165,179,
      74,133
10010 DATA177,144,7,165,181,41,6,76,113
      ,3,165,181,41,9,133,181,169,24,56
      ,229
10020 DATA177,48,35,133,177,56,233,25,1
      6,35,169,128,133,180,169,0,133,17
      9,164
10030 DATA177,240,14,105,40,144,5,230,1
      80,24,234,234,136,208,244,133,179
      ,165
10040 DATA178,48,73,133,178,56,233,40,1
      6,66,165,179,101,178,144,2,230,18
      0,133
10050 DATA179,160,0,162,15,234,234,234,
      177,179,168,221,239,3,240,5,202,1
      6,248
10060 DATA162,0,138,5,181,76,204,3,69,1
      81,170,234,234,234,189,239,3,162,
      0,129
10070 DATA179,169,0,96,120,210,255,0,25
      5,0,255,0,255,0,255,0,255,0,96,23
      9,239
10080 DATA239,239,239,239,32,108,124,22
      5,126,127,226,251,123,98,255,254,
      97,252
10090 DATA236,160,999
```

The program shown is set up for processing the data produced from an experiment to determine the mass flow rate/efficiency and the mass flow rate/pressure of a compressor. This program will give the user five prompting questions to which the user has to give a pre-determined number of answers. The data does not have to be input in a sorted form, the program will sort the data by column when the input has finished. Note that when changing the program the sort routine works with the data input in response to the first question. Ensure that you choose the first question to have a response which will not produce a constant value eg. If you ask for the water inlet temperature you will get a response wich will be very similar: 24 degrees.

The program is very modular and only a few of the modules need to be altered to run data from different experiments so rather than deal with how the program works I will give instructions for changing it.

Firstly decide what data you are going to need in the experiment. As an example I am going to plot the graphs of two functions with two variables A and B with a constant C.

The two functions are:-
Y=X*X+Z where X=A/B  and
Y=SQR(ABS(X*X+Z)) where X=A+B

DATA MODULE subroutine 9000

The data module determines the framework for the data base to be used in the program.

Lines 9010-9070 ask the questions and wait for the users response. The first item to change is in line 9030. The number gives the number of questions which are going to be asked. There are two sets of data required from the user so change the line to read:-

```
9030 DATA 2,INPUT A, INPUT B, END
```

Make sure you put END as the last item otherwise the program will stop. This gives a built in error check to ensure

that the program is being altered correctly.

Lines 9100-9180 are the graph titles. These are input in the order Main title, Y Axis and then X Axis, contrary to the REM statement in line 9110! The number of graphs to be plotted is entered as the first item of data eg.

```
9140 DATA 2,Y=X*X+Z,Y AXIS,X=A/B
9150 DATA Y=SQR(ABS(X*X+Z)),Y AXIS,X=A+B
```

Lines 9200+ give the number of sets of output data. There are going to be four sets of output data so OD=4. When the data is going to be scaled it needs to know which axis the data is going to be plotted on. Hence G$="XYXY"

The rest of the data in this section is for the double density plot routine.

PLOT CONTROLLER MODULE subroutine 7000

The data for the program is held in a two dimensional array. The first two rows in the T array will be taken up by A in row 1 and B in row 2. Rows 3-6 are going to hold the output data in the form given in G$ and for the graph titles. So now:-

```
7105 XP=3
7110 YP=4
7205 XP=5
7210 YP=6
```

MINOR INPUT MODULE subroutine 6000

The next change to be made is to get the constants for the program to be input. Line 6040 is very important and should be left alone. Lines 6050+ can be altered to give any constants used in the experiment eg.

```
6050 INPUT"INPUT THE CONSTANT C";Z
```

CALCULATION MODULE subroutine 2000

The calculation module is the most difficult routine to change as you are actually working within the program. To simplify the procedure follow the general outline which I have given in the routine for transfering the variables from the array into the single letter variables.

Line 2005-2010 print a title on the screen so that the data from the experiment can be copied down. The subroutine is printed in full below:-

```
2000 REM **** CALCULATION MODULE ***
2001 REM
2002 REM
2010 PRINT"X=A/B * Y * X=X+B * Y":PRINT
2015 FOR CO=1 TO ND
2020 A=T(1,CO): B=T(2,CO)
2030 J=A/B: K=J*J+Z
2040 L=A+B: M=SQR(ABS(L+Z))
2110 T(3,CO)=J: T(4,CO)=K
2115 T(5,CO)=L: T(6,CO)=M
2120 PRINTJ,K,L,M
2130 NEXT CO
2135 PRINT"PRESS THE SPACE BAR"
2140 GET A$:IF A$<>" "GOTO 2140
2150 RETURN
3000 REM
```

The program is not fully protected against all user entries so please ensure that any special cases which may occur are considered in the calculations ie division by zero and overflow errors.

# PET Sort


## Nick Marcopoulos, Dataview Ltd.


In issue 7 of the newsletter, a version of Shell-sort in BASIC was presented from W. Murcott. This article introduces a new sorting program which is in fact a modified version of the same sorting algorithm and which has been redesigned from the beginning for PET BASIC. This article also introduces a new methodology for writing more efficient and tailor made routines of similar type for the Commodore PET and explains why a Shellsort type algorithm seems to be more suitable.

A vast amount of time and effort has been already spent on sorting. If you want to get an idea of this just have a glance in the very well known book on this subject written by Donald Knuth (The Art of Computer Programming, Vol 3, Sorting and Searching, Addison Wesley).

To start with there is no 'best' sorting algorithm. All of them become very slow when sorting large arrays. The simplest 'bubble sort' which is in fact very fast for small arrays becomes extremely inefficient for large ones since for a double size array the time needed is four times as much, or, to put it more formally, the sorting speed is proportional to N 2, where N is the size of the array.

All the sorting algorithms compare the elements of the array and exchange them until the array is sorted. There is no doubt that most of the processing time is spent doing comparisons and exchanges and efforts have been made to minimise the number of the comparisons and exchanges needed as much as possible.

There is a theoretical limit to this minimum so that in the best case the number of comparisons and exchanges is at least proportional to N*LOGN where LOG is in base 2. Some of the algorithms managed to reach this limit, in fact Quicksort is (in theory) of order N*LOGN and Shellsort about 1.3*N*LOGN. However all these algorithms have an additional overhead in computation different to comparisons and exchanges. Moreover the actual implementation is done in high level languages and there are substantial

The routine sits in the second cassette buffer and is called by SYS 826. Below are two methods for loading the routine, source code and BASIC loader.

```
SOUR*......PAGE 0001

LINE# LOC  CODE       LINE

0001  0000           PTR     = $00
0002  0000           *=$033A
0003  033A  A9 00     LDA #$00
0004  033C  85 00     STA PTR         ;LO
0005  033E  A9 04     LDA #$04
0006  0340  85 01     STA PTR+1       ;HI BYTE START OF SEARCH
0007  0342  A0 00     LDY #$00        ;ZERO INDIRECT POINTER
0008  0344  20 99 03  ENDL    JSR INCR         ;
0009  0347  B1 00     LDA (PTR),Y     ;EXAMINE LINKS
0010  0349  8D AC 03  STA EP          ;FOR END OF
0011  034C  20 99 03  JSR INCR        ;PROGRAM
0012  034F  B1 00     LDA (PTR),Y     ;
0013  0351  0D AC 03  ORA EP          ;
0014  0354  F0 37     BEQ ENDP        ;TOTAL LINK = 0
0015  0356  20 99 03  JSR INCR        ;LINE # LO
0016  0359  20 99 03  JSR INCR        ;LINE # HI
0017  035C  A9 00     LDA #$00
0018  035E  8D AD 03  STA QTF         ;CLEAR QUOTE FLAG
0019  0361  8D AE 03  STA REMF        ;CLEAR REM FLAG
0020  0364  20 99 03  NCR     JSR INCR         ;FIRST / NEXT CHAR
0021  0367  B1 00     LDA (PTR),Y
0022  0369  F0 D9     BEQ ENDL        ;END OF BASIC LINE
0023  036B  C9 22     CMP #'"         ;QUOTES ?
0024  036D  F0 1F     BEQ QTMF        ;YES FLIP QUOTE FLAG
0025  036F  C9 8F     CMP #$8F        ;IS IT REM
0026  0371  D0 03     BNE CHAR        ;NO
0027  0373  8D AE 03  STA REMF        ;YES SET REM FLAG
0028  0376  CD AF 03  CHAR    CMP SYMBL        ;IS IT SYMBOL
0029  0379  D0 E9     BNE NCR         ;NO NEXT CHARACTER
0030  037B  AD AD 03  LDA QTF         ;YES CHECK QUOTE FLAG
0031  037E  D0 E4     BNE NCR         ;QUOTE FLAG SET
0032  0380  AD AE 03  LDA REMF
0033  0383  D0 DF     BNE NCR
0034  0385  AD B0 03  LDA TOKEN       ;LOAD KEY TOKEN
0035  0388  91 00     STA (PTR),Y     ;STORE IN BASIC TEXT
0036  038A  4C 64 03  JMP NCR         ;NEXT CHARACTER
0037  038D  60        ENDP    RTS              ;FINISHED TO BASIC
0038  038E  AD AD 03  QTMF    LDA QTF          ;
0039  0391  49 01     EOR #$01        ;FLIP QUOTE FLAG
0040  0393  8D AD 03  STA QTF         ;
0041  0396  4C 64 03  JMP NCR
0042  0399  18        INCR    CLC              ;INCREMENT POINTER
0043  039A  A5 00     LDA PTR
0044  039C  69 01     ADC #$01
0045  039E  85 00     STA PTR
0046  03A0  A5 01     LDA PTR+1
0047  03A2  69 00     ADC #$00
0048  03A4  85 01     STA PTR+1
0049  03A6  C9 80     CMP #$80
0050  03A8  F0 01     BEQ ERROR
0051  03AA  60        RTS
0052  03AB  00        ERROR   BRK
0053  03AC  00        EP      .BYTE 0
0054  03AD  00        QTF     .BYTE 0
0055  03AE  00        REMF    .BYTE 0
0056  03AF  21        SYMBL   .BYTE '!'
0057  03B0  85        TOKEN   .BYTE $85
0058  03B1                    .END

ERRORS = 0000
```

PROGRAM NAME: SHORT INPUT

```
10 REM ! TO GIVE INPUT
20 FOR L = 826 TO 944
30 READ C : POKE L , C
40 NEXT L
50 NEW
100 DATA169,0,133,0,169,4,133,1,160,0
110 DATA32,153,3,177,0,141,172,3,32,153
120 DATA3,177,0,13,172,3,240,55,32,153
130 DATA3,32,153,3,169,0,141,173,3,141
140 DATA174,3,32,153,3,177,0,240,217
150 DATA201,34,240,31,201,143,208,3,141
160 DATA174,3,205,175,3,208,233,173,173
170 DATA3,208,228,173,174,3,208,223,173
180 DATA176,3,145,0,76,100,3,96,173,173
190 DATA3,73,1,141,173,3,76,100,3,24
200 DATA165,0,105,1,133,0,165,1,105,0
210 DATA133,1,201,128,240,1,96,0,0,0,0
220 DATA33,133
```

PROGRAM NAME: INPUT TEST

```
10 REM ** DEMONSTRATION / TEST PROGRAM
   **
20 SYS 826 : REM ENSURE ALL !'S ARE INP
   UT FOR THIS RUN
30 REM THIS IS A TEST !!!
40 ! "WHAT IS YOUR NAME ";N$
50 ! "HOW OLD ARE YOU ";A
60 PRINT N$;" YOU ARE ABOUT";A*365;"DAY
   S OLD !!!"
70 GOTO 30
```

# User Club & Bits and Pieces

Dave Middleton

## Software Prizes

In Volume 2 Number 2, Andrew Goltz announced the introduction of the software prize for the best article in CPUCN, the prizes being 50 pounds for the best article in the issue and a 250 pound prize for the best article in the volume . Very little publicity has been given to this and I would suspect that most readers forgot all about it. The decision for who would get the prizes was fairly difficult. Jim Butterfield has been so prolific the he should by rights win all the prizes but that would be a bit pointless as he has access to any software he requires. Also a lot of material is produced 'in house', Mike Gross-Niklaus and Paul Higginbottom are prime examples.

This leaves a fairly small amount of original work produced outside Commodore UK. We have published a lot of small items about programming but there have been very few articles sent in which extend over more than one page but those we have had are generally very good.

Here are the 50 pound software prizes:

| No. | Name | Article |
|---|---|---|
| 1 | D.Muir | Digital to Analogue Conversion. |
| 2 | Mike Todd | Owners Report. |
| 4 | RJ Leman | Assembling an Assembler. |
| 5 | LJ Slow | Sorting by Insertion & chaining. |
| 7 | AR Clarke<br>CD Smith | Far infra-red astronomy ground station. |
| 7 | DA Hills | Supermon Old ROM. |
| 8 | D Doyle | DIMP. |
| 8 | R Davis | The 'ultimate' screen save. |
| 5 | Bob Sparks | TVA meter for the physics lab. |

The 250 pound software prize for volume 2 goes to:

If the above people would like to write to me giving their choice of software from the current Petpack Master Library catalogue I will arrange to have the programs sent.

I hope this will tempt a few more of you into taking up the pen or better still Wordpro and putting your thoughts, applications, programs or ideas onto paper, it is suprisingly easy once you get started.

Dave Middleton

## A review of Adventure

Adventure is a very difficult game to describe because it is so unusual and because if too much information is given away then the game is spoilt.

First a very short history of the game. It was written by two programmers Willie Crowther and Don Woods as the Massachusetts Institute of Technology as an exercise in Artificial Intelligence. The original program was written in FORTRAN which is quite amazing as FORTRAN is not exactly renowned for its string handling capabilities! The game has had an enormous secret following for years as just about every main-frame computer has a copy lurking in the depths of its disk packs which is played by a small band of devotees at enormous cost to the company.

It can hardly be a suprise that PET Adventure has been made available by Jim Butterfield who has converted the FORTRAN code into its BASIC equivalent. The main Adventure program is 12k long and when the text files are included this comes to a massive 56k! To run Adventure you will need a 32k PET and a disk system with Adventure running on drive 0.

This has great significance in making your source listings legible. If you make a nice legible listing, then not only will you be able to understand your own listings when you come to look at them in a years time, but other people should be able to as well.

The following program started as an exercise in managing a strip of memory as a two dimensional array for managing the screen as a window on a sheet (Visicalc do I hear you say). However as per usual, as I began to write this I kept on thinking of other features that would be nice, and so it grew and grew. The listing that follows is quite heavily commented but never the less a full description of how this works will be necessary next time. If you wish to try the program, there are some systems variables at the start that you may need to change (screen size, sheet width etc.).

This listing uses a lot of symbols whereas the others haven't. The reason for this is that it would have been possible to type in the previous programs into the monitor, or by using SUPERMON or EXTRAMON, but this one is strictly for assembler users only.

More next time...Good luck.

```
HOPE1.S......PAGE 0001

LINE# LOC   CODE        LINE

0001  0000              ;***************************
0002  0000              ;*                         *
0003  0000              ;* SYSTEM VARIABLES:-      *
0004  0000              ;* TXTWID - TEXT WIDTH     *
0005  0000              ;* SCRSIZ - SCREEN SIZE    *
0006  0000              ;*          (40 OR 80)     *
0007  0000              ;* TEXT IS SELF ORGANISING *
0008  0000              ;* I.E WIDER TEXT GIVES    *
0009  0000              ;* LESS LINES.             *
0010  0000              ;*                         *
0011  0000              ;* BY PAUL HIGGINBOTTOM    *
0012  0000              ;*                         *
0013  0000              ;***************************
0014  0000              ;
0015  0000              TXTWID =132             ;WIDTH OF TEXT
0016  0000              SCRSIZ =80              ;LENGTH OF SCREEN LINE
0017  0000              BLHC   =34688           ;BOTTOM LEFT HAND CORNER ADDRESS
0018  0000              ;
0019  0000              ;ZERO PAGE STORAGE DECLARATIONS
0020  0000              ;
0021  0000              LINE   =$23             ;LINE IN TEXT
0022  0000              LOC    =$24             ;POINTER TO SCREEN LOCATION
0023  0000              UNDCSR =$26             ;CHARACTER UNDER CURSOR
0024  0000              MAXLIN =$27             ;MAXIMUM LINE NUMBER
0025  0000              TXTEND =$34             ;TOP OF MEM./END OF TEXT POINTER
0026  0000              RDELAY =$5E             ;DELAY BEFORE REPEAT
0027  0000              SAVCHR =$5F             ;CHARACTER SAVE
0028  0000              REPDY  =$60             ;DELAY BETWEEN REPEATS
0029  0000              IRQSAV =$61             ;SAVE CURRENT IRQ VECTOR
0030  0000              PTR1   =$66             ;POINTER TO TEXT LOCATION OF HOME
0031  0000              PTR2   =$68             ;SPARE POINTER
0032  0000              PTR3   =$6A             ;SPARE POINTER
0033  0000              POSNTX =$00             ;POSITION ON TEXT LINE
0034  0000              POSNSC =$01             ;POSITION ON SCREEN LINE
0035  0000              SCRLIN =$02             ;LINE ON SCREEN
0036  0000              TIMER  =$8F             ;JIFFY CLOCK LSD
0037  0000              IRQLO  =$90             ;INTERRUPT VECTOR LO
0038  0000              IRQHI  =$91             ;INTERRUPT VECTOR HI
0039  0000              KEY    =$97             ;UNSHIFTED ASCII KEYPRESS
0040  0000              RVSFLG =$9F             ;REVERSE FLAG
0041  0000              SCREEN =32768           ;SCREEN START ADDRESS
0042  0000              DELAY  =$F4             ;CURSOR BLINK DELAY
0043  0000              ;
0044  0000              ;ROM ROUTINE DECLARATIONS
0045  0000              ;
0046  0000              GET    =$FFE4           ;GET A CHARACTER
0047  0000              PRT    =$FFD2           ;PRINT A CHARACTER
0048  0000              ;
0049  0000                     *=$1000          ;STARTS AT 4096 DEC.
0050  1000              ;
0051  1000              ;SET PTR1 (POINTER 1) TO LO AND HI OF TEXT ADDRESS
0052  1000              ;
0053  1000  A9 89        START  LDA #<TEXT
0054  1002  85 66               STA PTR1
0055  1004  A9 12               LDA #>TEXT
```

```
LINE# LOC   CODE        LINE

0056  1006  85 67             STA PTR1+1
0057  1008                   ;
0058  1008                   ;SET LOC (SCREEN LOCATION) TO HOME POSITION
0059  1008                   ;
0060  1008  A9 00             LDA #<SCREEN
0061  100A  85 24             STA LOC
0062  100C  A9 80             LDA #>SCREEN
0063  100E  85 25             STA LOC+1
0064  1010                   ;
0065  1010                   ;ZEROISE Y AND VARIABLES
0066  1010                   ;
0067  1010  A0 00             LDY #0
0068  1012  84 00             STY POSNTX      ;POSITION ON TEXT
0069  1014  84 01             STY POSNSC      ;POSITION ON SCREEN
0070  1016  84 23             STY LINE        ;CURRENT LINE IN TEXT
0071  1018  84 02             STY SCRLIN      ;CURRENT LINE ON SCREEN
0072  101A  84 9F             STY RVSFLG      ;REVERSE FLAG
0073  101C  84 27             STY MAXLIN      ;MAXIMUM LINE NUMBER
0074  101E  C6 27             DEC MAXLIN      ;SET TO $FF AT START
0075  1020  A5 90             LDA IRQLO       ;SAVE CURRENT IRQ
0076  1022  85 61             STA IRQSAV
0077  1024  A5 91             LDA IRQHI
0078  1026  85 62             STA IRQSAV+1
0079  1028  A2 84             LDX #TXTWID     ;SET X TO TEXT WIDTH
0080  102A  78                SEI             ;DISABLE INTERRUPTS FOR SPEED
0081  102B                   ;
0082  102B                   ;STORE SPACES IN ALL TEXT AREA (32'S)
0083  102B                   ;
0084  102B  A9 20        CLRTXT LDA #32          ;LOAD A SPACE
0085  102D  91 66             STA (PTR1)Y     ;STORE IT
0086  102F  20 18 12          JSR INCPT1      ;INCREMENT PTR1
0087  1032                   ;
0088  1032                   ;COUNTS NUMBER OF LINES IN TEXT AREA
0089  1032                   ;SO THAT IF THE TEXT WIDTH IS SMALL,
0090  1032                   ;THERE WILL BE A LOT OF LINES AVAILABLE,
0091  1032                   ;SIMILARLY IF A WIDER TEXT IS USED, THEN
0092  1032                   ;LESS LINES WILL BE AVAILABLE.
0093  1032                   ;
0094  1032  CA                DEX             ;DECREMENT CHARACTER COUNT
0095  1033  D0 04             BNE CLRT10      ;NOT ZERO - GO ON
0096  1035  A2 84             LDX #TXTWID     ;ZERO - SET IT AGAIN
0097  1037  E6 27             INC MAXLIN      ;INCREMENT NUMBER OF LINES
0098  1039                   ;
0099  1039  A5 67        CLRT10 LDA PTR1+1       ;GET HI BYTE OF POINTER
0100  103B  C5 35             CMP TXTEND+1    ;COMPARE WITH END OF MEMORY ?
0101  103D  D0 EC             BNE CLRTXT      ;NOT THE SAME - MORE TO DO
0102  103F  A5 66             LDA PTR1        ;THE SAME....
0103  1041  C5 34             CMP TXTEND      ;HOW ABOUT THE LO BYTE ?
0104  1043  D0 E6             BNE CLRTXT      ;NO - STILL MORE TO DO
0105  1045                   ;
0106  1045  A9 89             LDA #<TEXT      ;SET POINTER TO TEXT START
0107  1047  85 66             STA PTR1
0108  1049  A9 12             LDA #>TEXT
0109  104B  85 67             STA PTR1+1
0110  104D  58                CLI             ;RESET INTERRUPTS
```

```
LINE# LOC   CODE        LINE

0111  104E  20 28 12           JSR ONREP       ;TURN ON REPEAT
0112  1051                ;
0113  1051  78            MAIN  SEI              ;DISABLE INTERRUPTS FOR SPEED
0114  1052  A9 00              LDA #<SCREEN    ;SET PTR2 TO HOME
0115  1054  85 68              STA PTR2
0116  1056  A9 80              LDA #>SCREEN
0117  1058  85 69              STA PTR2+1
0118  105A  A5 66              LDA PTR1        ;TRANSFER PTR1 TO PTR3
0119  105C  85 6A              STA PTR3        ;FOR USAGE
0120  105E  A5 67              LDA PTR1+1
0121  1060  85 6B              STA PTR3+1
0122  1062  A2 19              LDX #25         ;SET SCREEN LINE COUNT
0123  1064                ;
0124  1064  A0 4F          DISP10 LDY #SCRSIZ-1   ;SET CHAR. COUNT
0125  1066                ;
0126  1066  B1 6A          DISP20 LDA (PTR3)Y     ;GET FROM TEXT
0127  1068  91 68              STA (PTR2)Y     ;DISPLAY ON SCREEN
0128  106A  88                 DEY             ;DECREMENT CHARACTER COUNT
0129  106B  10 F9              BPL DISP20      ;>=0 - DO MORE
0130  106D                ;
0131  106D  CA                 DEX             ;DECREMENT LINE COUNT
0132  106E  F0 1C              BEQ DISP99      ;IF ZERO - DONE
0133  1070  18                 CLC             ;ADD TEXT WIDTH TO PTR1
0134  1071  A5 6A              LDA PTR3
0135  1073  69 84              ADC #TXTWID
0136  1075  85 6A              STA PTR3
0137  1077  A5 6B              LDA PTR3+1
0138  1079  69 00              ADC #0
0139  107B  85 6B              STA PTR3+1
0140  107D                ;
0141  107D  18                 CLC             ;ADD SCREEN SIZE TO PTR2
0142  107E  A5 68              LDA PTR2
0143  1080  69 50              ADC #SCRSIZ
0144  1082  85 68              STA PTR2
0145  1084  A5 69              LDA PTR2+1
0146  1086  69 00              ADC #0
0147  1088  85 69              STA PTR2+1
0148  108A  D0 D8              BNE DISP10      ;AND CARRY ON
0149  108C                ;
0150  108C  58            DISP99 CLI             ;RE-ENABLE INTERRUPTS
0151  108D                ;
0152  108D                ;LOC,LOC+1 POINTS TO THE START
0153  108D                ;OF THE CURRENT SCREEN LINE.
0154  108D                ;
0155  108D                ;PROGRAM USES POSNSC (SCREEN POSITION)
0156  108D                ;AS Y OFFSET IN LOAD INDIRECT 'LOC'
0157  108D                ;TO OBTAIN THE CURRENT CONTENTS
0158  108D                ;OF ANY SCREEN LOCATION.
0159  108D                ;
0160  108D  A4 01          BEGIN  LDY POSNSC      ;GET SCREEN POSITION
0161  108F  B1 24              LDA (LOC)Y      ;GET CHARACTER
0162  1091  85 26              STA UNDCSR      ;SAVE IT FOR LATER
0163  1093  20 1F 12      BEG10  JSR FLIP        ;BLINK CURSOR
0164  1096  A9 F4              LDA #DELAY      ;SET TIMER TO DELAY
0165  1098  85 8F              STA TIMER       ;(JIFFY CLOCK)
```

```
LINE# LOC    CODE          LINE

0166  109A                ;
0167  109A                ;JSR GET - 'GET'S A CHARACTER FROM
0168  109A                ;THE KEYBOARD AND PUTS IT INTO THE
0169  109A                ;ACCUMULATOR. A ZERO IS RETURNED,
0170  109A                ;IF NO KEY HAS BEEN PRESSED.
0171  109A                ;
0172  109A  20 E4 FF     WAIT   JSR GET          ;GET A CHARACTER
0173  109D  D0 06               BNE GOTONE      ;GOT ONE - GO ON
0174  109F  A5 8F               LDA TIMER       ;TEST TIMER
0175  10A1  D0 F7               BNE WAIT        ;GET AGAIN
0176  10A3  F0 EE               BEQ BEG10       ;FLIP CURSOR AGAIN
0177  10A5                ;
0178  10A5  48           GOTONE PHA             ;SAVE KEYPRESS ON STACK
0179  10A6  A5 26               LDA UNDCSR      ;GET CHAR. UNDER CURSOR
0180  10A8  A4 01               LDY POSNSC      ;LOAD OFFSET WITH SCREEN POSITION
0181  10AA  91 24               STA (LOC)Y      ;STORE CHAR. BACK THERE
0182  10AC  68                  PLA             ;GET SAVED KEYPRESS
0183  10AD  C9 1D               CMP #29         ;CURSOR RIGHT ?
0184  10AF  D0 24               BNE GOT5        ;NO - GO ON
0185  10B1                ;
0186  10B1                ;HANDLE CURSOR RIGHT
0187  10B1                ;
0188  10B1  A5 01        RT     LDA POSNSC      ;GET SCREEN POSITION
0189  10B3  C9 4F               CMP #SCRSIZ-1   ;AT RIGHT HAND SIDE ?
0190  10B5  D0 17               BNE RT10        ;NO - GO ON
0191  10B7  A5 00               LDA POSNTX      ;GET TEXT POSITION
0192  10B9  C9 83               CMP #TXTWID-1   ;AT EDGE OF SHEET ?
0193  10BB  D0 03               BNE RT5         ;NO - GO ON
0194  10BD  4C 51 10            JMP MAIN        ;YES - CARRY ON
0195  10C0  18           RT5    CLC             ;BUMP SCREEN LEFT BY 1
0196  10C1  A5 66               LDA PTR1        ;BY ADDING ONE TO PTR1
0197  10C3  69 01               ADC #1
0198  10C5  85 66               STA PTR1
0199  10C7  A5 67               LDA PTR1+1
0200  10C9  69 00               ADC #0
0201  10CB  85 67               STA PTR1+1
0202  10CD  2C                  .BYT $2C        ;SKIP 2 BYTES
0203  10CE                ;
0204  10CE  E6 01        RT10   INC POSNSC      ;ELSE - BUMP SCREEN POS.
0205  10D0  E6 00               INC POSNTX      ;AND TEXT POSITION
0206  10D2  4C 51 10            JMP MAIN        ;AND REDISPLAY IT
0207  10D5                ;
0208  10D5  C9 12        GOT5   CMP #18         ;REVERSE ?
0209  10D7  D0 07               BNE GOT7        ;NO - GO ON
0210  10D9  A2 80               LDX #$80        ;YES - SET REVERSE FLAG
0211  10DB  86 9F               STX RVSFLG
0212  10DD  4C 8D 10            JMP BEGIN       ;AND CARRY ON
0213  10E0                ;
0214  10E0  C9 92        GOT7   CMP #146        ;OFF RVS ?
0215  10E2  D0 07               BNE GOT10       ;NO - GO ON
0216  10E4  A2 00               LDX #$00        ;YES - RESET REVERSE FLAG
0217  10E6  86 9F               STX RVSFLG
0218  10E8  4C 8D 10            JMP BEGIN       ;AND CARRY ON
0219  10EB                ;
0220  10EB  C9 9D        GOT10  CMP #157        ;CURSOR LEFT ?
```

```
LINE# LOC    CODE          LINE

0221  10ED   D0 20         BNE GOT20       ;NO - GO ON
0222  10EF                 ;
0223  10EF                 ;HANDLE CURSOR LEFT
0224  10EF                 ;
0225  10EF   A5 01         LF      LDA POSNSC      ;AT LHS OF SCREEN ?
0226  10F1   D0 15                 BNE LF10        ;NO - GO ON
0227  10F3   A5 00                 LDA POSNTX      ;AT EDGE OF SHEET
0228  10F5   D0 03                 BNE LF5         ;NO - GO ON
0229  10F7   4C 51 10              JMP MAIN        ;YES - GO BACK
0230  10FA   38           LF5     SEC             ;BUMP SCREEN RIGHT BY 1
0231  10FB   A5 66                 LDA PTR1
0232  10FD   E9 01                 SBC #1
0233  10FF   85 66                 STA PTR1
0234  1101   A5 67                 LDA PTR1+1
0235  1103   E9 00                 SBC #0
0236  1105   85 67                 STA PTR1+1
0237  1107   2C                   .BYT $2C        ;SKIP 2 BYTES
0238  1108                 ;
0239  1108   C6 01         LF10    DEC POSNSC      ;ELSE BUMP SCREEN POSN
0240  110A   C6 00                 DEC POSNTX      ;DECREMENT TEXT POSITION
0241  110C   4C 51 10              JMP MAIN        ;AND REDISPLAY IT
0242  110F                 ;
0243  110F   C9 11         GOT20   CMP #17         ;CURSOR DOWN ?
0244  1111   D0 35                 BNE GOT30       ;NO - GO ON
0245  1113                 ;
0246  1113   A5 23         DN      LDA LINE        ;GET CURRENT LINE
0247  1115   C5 27                 CMP MAXLIN      ;AT BOTTOM OF TEXT ?
0248  1117   D0 03                 BNE DN10        ;NO - FINE
0249  1119   4C 8D 10              JMP BEGIN       ;YES - NO GO!
0250  111C                 ;
0251  111C   A5 02         DN10    LDA SCRLIN      ;ARE WE ON BOTTOM LINE ?
0252  111E   C9 18                 CMP #24
0253  1120   D0 12                 BNE DN30        ;NO - GO ON
0254  1122                 ;
0255  1122   18           DN20    CLC             ;YES - ADD TXTWID TO PTR1
0256  1123   A5 66                 LDA PTR1
0257  1125   69 84                 ADC #TXTWID
0258  1127   85 66                 STA PTR1
0259  1129   A5 67                 LDA PTR1+1
0260  112B   69 00                 ADC #0
0261  112D   85 67                 STA PTR1+1
0262  112F   E6 23                 INC LINE
0263  1131   4C 51 10              JMP MAIN        ;AND REDISPLAY IT
0264  1134                 ;
0265  1134   E6 23         DN30    INC LINE        ;ELSE BUMP LINE
0266  1136   18                   CLC             ;AND ADD SCREEN SIZE TO LOC
0267  1137   A5 24                 LDA LOC
0268  1139   69 50                 ADC #SCRSIZ
0269  113B   85 24                 STA LOC
0270  113D   A5 25                 LDA LOC+1
0271  113F   69 00                 ADC #0
0272  1141   85 25                 STA LOC+1
0273  1143   E6 02                 INC SCRLIN
0274  1145   4C 8D 10              JMP BEGIN       ;AND CARRY ON
0275  1148                 ;
```

```
LINE# LOC   CODE        LINE

0276  1148  C9 91       GOT30  CMP #145         ;CURSOR UP ?
0277  114A  D0 31              BNE GOT40       ;NO - GO ON
0278  114C              ;
0279  114C  A5 02       UP     LDA SCRLIN       ;ON TOP LINE OF SCREEN ?
0280  114E  D0 19              BNE UP30        ;NO - GO ON
0281  1150              ;
0282  1150  A5 23       UP10   LDA LINE         ;AT TOP OF SHEET ?
0283  1152  D0 03              BNE UP20        ;NO - GO ON
0284  1154  4C 8D 10           JMP BEGIN       ;YES - NO GO!
0285  1157              ;
0286  1157  38         UP20   SEC              ;SUBTRACT TEXTWIDTH FROM PTR1
0287  1158  A5 66              LDA PTR1
0288  115A  E9 84              SBC #TXTWID
0289  115C  85 66              STA PTR1
0290  115E  A5 67              LDA PTR1+1
0291  1160  E9 00              SBC #0
0292  1162  85 67              STA PTR1+1
0293  1164  C6 23              DEC LINE        ;DECREMENT LINE
0294  1166  4C 51 10           JMP MAIN        ;AND REDISPLAY IT
0295  1169              ;
0296  1169  C6 23       UP30   DEC LINE         ;ELSE BUMP LINE
0297  116B  38                 SEC             ;AND SUBTRACT SCRSIZ FROM LOC
0298  116C  A5 24              LDA LOC
0299  116E  E9 50              SBC #SCRSIZ
0300  1170  85 24              STA LOC
0301  1172  A5 25              LDA LOC+1
0302  1174  E9 00              SBC #0
0303  1176  85 25              STA LOC+1
0304  1178  C6 02              DEC SCRLIN
0305  117A  4C 8D 10           JMP BEGIN       ;AND CARRY ON
0306  117D              ;
0307  117D  C9 03       GOT40  CMP #3           ;STOP ?
0308  117F  D0 04              BNE GOT43       ;NO - GO ON
0309  1181  20 33 12           JSR OFFREP      ;YES - TURN OFF REPEAT
0310  1184  60                 RTS             ;AND RETURN TO BASIC
0311  1185              ;
0312  1185  C9 14       GOT43  CMP #20          ;DELETE ?
0313  1187  D0 2B              BNE GOT46       ;NO - GO ON
0314  1189              ;
0315  1189  A4 00       DEL    LDY POSNTX       ;GET TEXT POSITION
0316  118B  D0 03              BNE DEL5        ;NOT ZERO - MORE
0317  118D  4C 8D 10           JMP BEGIN       ;IS - GO BACK
0318  1190              ;
0319  1190  20 6B 12     DEL5   JSR CALC         ;CALCULATE POSITION
0320  1193  A4 00              LDY POSNTX      ;SET OFFSET
0321  1195              ;
0322  1195  B1 68       DEL10  LDA (PTR2)Y      ;GET ONE
0323  1197  88                 DEY             ;MOVE BACK ONE SPACE
0324  1198  91 68              STA (PTR2)Y     ;MOVE IT
0325  119A  C8                 INY             ;BACK TO WHERE IT WAS
0326  119B  C8                 INY             ;AND ONTO THE NEXT
0327  119C  C0 84              CPY #TXTWID     ;FINISHED ?
0328  119E  D0 F5              BNE DEL10       ;NO - KEEP GOING
0329  11A0              ;
0330  11A0              ;PUT A SPACE INTO LAST POSITION
```

```
LINE# LOC    CODE          LINE

0331  11A0                ;
0332  11A0  A0 83          LDY #TXTWID-1
0333  11A2  A9 20          LDA #32
0334  11A4  91 68          STA (PTR2)Y
0335  11A6  A5 01          LDA POSNSC      ;AT EDGE OF SCREEN ?
0336  11A8  D0 03          BNE DEL20       ;NO - GO ON
0337  11AA  4C EF 10       JMP LF          ;YES MOVE LEFT
0338  11AD                ;
0339  11AD  C6 01          DEL20  DEC POSNSC     ;ELSE DECR. SCRN POS
0340  11AF  C6 00          DEC POSNTX      ;AND TEXT POSITION
0341  11B1  4C 51 10       JMP MAIN        ;AND REDISPLAY IT
0342  11B4                ;
0343  11B4  C9 94          GOT46  CMP #148       ;INSERT ?
0344  11B6  D0 1E          BNE GOT50       ;NO - GO ON
0345  11B8                ;
0346  11B8  20 6B 12       INS    JSR CALC       ;CALCULATE POSITION
034/  11BB                ;
0348  11BB  A0 82          INS5   LDY #TXTWID-2  ;START AT RHS OF TEXT
0349  11BD                ;
0350  11BD  C4 00          INS10  CPY POSNTX     ;DONE ?
0351  11BF  90 0C          BCC INS20       ;YES - GO ON
0352  11C1  B1 68          LDA (PTR2)Y     ;GET A CHARACTER
0353  11C3  C8             INY             ;MOVE ONTO NEXT SQUARE
0354  11C4  91 68          STA (PTR2)Y     ;PUT IT THERE
0355  11C6  88             DEY             ;BACK TO WHERE WE WERE
0356  11C7  F0 04          BEQ INS20       ;IF IN 1ST - STOP
035/  11C9  88             DEY             ;AND ONTO THE NEXT
0358  11CA  4C BD 11       JMP INS10       ;AND CARRY ON
0359  11CD                ;
0360  11CD  A4 00          INS20  LDY POSNTX     ;GET OFFSET
0361  11CF  A9 20          LDA #32         ;AND PUT SPACE THERE
0362  11D1  91 68          STA (PTR2)Y
0363  11D3  4C 51 10       JMP MAIN        ;CARRY ON
0364  11D6                ;
0365  11D6  C9 13          GOT50  CMP #19        ;HOME ?
0366  11D8  D0 1D          BNE GOT60       ;NO - GO ON
0367  11DA                ;
0368  11DA  A9 89          HM     LDA #<TEXT     ;RESET POINTER
0369  11DC  85 66          STA PTR1
0370  11DE  A9 12          LDA #>TEXT
0371  11E0  85 67          STA PTR1+1
0372  11E2  A9 00          LDA #<SCREEN   ;AND LOC
0373  11E4  85 24          STA LOC
0374  11E6  A9 80          LDA #>SCREEN
0375  11E8  85 25          STA LOC+1
0376  11EA  A0 00          LDY #0         ;AND VARIABLES
0377  11EC  84 00          STY POSNTX     ;TEXT POSITION
0378  11EE  84 01          STY POSNSC     ;SCREEN POSITION
0379  11F0  84 23          STY LINE       ;AND LINE
0380  11F2  84 02          STY SCRLIN     ;AND SCREEN LINE
0381  11F4  4C 51 10       JMP MAIN       ;AND CARRY ON
0382  11F7                ;
0383  11F7  C9 93          GOT60  CMP #147       ;CLR HME ?
0384  11F9  D0 06          BNE OUT10       ;NO - GO ON
0385  11FB  20 33 12       JSR OFFREP      ;YES - DISABLE REPEAT
```

```
LINE# LOC   CODE        LINE

0386  11FE  4C 00 10          JMP START      ;AND START AGAIN
0387  1201                   ;
0388  1201                   ;CONVERT KEYPRESS TO SCREEN CODE
0389  1201                   ;
0390  1201  48          OUT10  PHA             ;SAVE IT
0391  1202  0A                 ASL A          ;PUT BIT 7 INTO CARRY
0392  1203  68                 PLA            ;REGET IT
0393  1204  29 3F              AND #$3F       ;MASK OUT TOP 2 BITS
0394  1206  90 02              BCC OUT20      ;IF BIT7 SET - GO ON
0395  1208  09 40              ORA #$40       ;ELSE SET BIT6
0396  120A                   ;
0397  120A  05 9F        OUT20  ORA RVSFLG      ;NEGATE IT IF IN RVS
0398  120C  48                 PHA            ;SAVE IT FOR LATER
0399  120D  20 6B 12           JSR CALC
0400  1210  A4 00              LDY POSNTX     ;SET OFFSET
0401  1212  68                 PLA            ;REGET CHARACTER
0402  1213  91 68              STA (PTR2)Y    ;STORE IT
0403  1215  4C B1 10           JMP RT         ;AND DO A CURSOR RIGHT
0404  1218                   ;
0405  1218                   ;SUBROUTINE TO DO A 16 BIT INCREMENT ON PTR1
0406  1218                   ;
0407  1218  E6 66        INCPT1 INC PTR1        ;INCREMENT LO BYTE
0408  121A  D0 02              BNE NOINC1     ;NOT ZERO - GO ON
0409  121C  E6 67              INC PTR1+1     ;ELSE - INCREMENT HI BYTE
0410  121E  60          NOINC1 RTS             ;AND RETURN
0411  121F                   ;
0412  121F                   ;SUBROUTINE TO NEGATE SCREEN POSITION
0413  121F                   ;
0414  121F  A4 01        FLIP   LDY POSNSC      ;LOAD OFFSET
0415  1221  B1 24              LDA (LOC)Y     ;GET IT
0416  1223  49 80              EOR #$80       ;FLIP IT
0417  1225  91 24              STA (LOC)Y     ;STORE IT BACK
0418  1227  60                 RTS            ;AND RETURN
0419  1228                   ;
0420  1228                   ;       !-----------------TXTWID---------------------!
0421  1228                   ;       !                                            !
0422  1228                   ;  TEXT-..............---SCRSIZ----..................
0423  1228                   ;       ..............!............!..................
0424  1228                   ;       ............/->.----------..................
0425  1228                   ;       ............^..!          !..................
0426  1228                   ;       ............^..!  SCREEN   !..................
0427  1228                   ;       ............^..!          !..................
0428  1228                   ;       ............^..!          !..................
0429  1228                   ;       ............^...----------..................
0430  1228                   ;       ............^.....................................
0431  1228                   ;       ............^.....................................
0432  1228                   ;                   PTR1
0433  1228                   ;
0434  1228                   ;ROUTINE TO ENABLE REPEAT FUNCTION
0435  1228                   ;BY CHANGING THE INTERRUPT VECTOR
0436  1228                   ;TO THE REPEAT CODE.
0437  1228                   ;
0438  1228  78          ONREP  SEI             ;DISABLE INTERRUPTS
0439  1229  A9 3E              LDA #<REPEAT   ;CHANGE IRQ TO REPEAT
0440  122B  85 90              STA IRQLO
```

```
LINE# LOC   CODE        LINE

0441  122D  A9 12       LDA #>REPEAT
0442  122F  85 91       STA IRQHI
0443  1231  58          CLI             ;RE-ENABLE INTERRUPTS
0444  1232  60          RTS             ;AND RETURN
0445  1233              ;
0446  1233              ;ROUTINE TO DISABLE REPEAT FUNCTION
0447  1233              ;BY CHANGING THE INTERRUPT VECTOR
0448  1233              ;TO ITS  ORIGINAL LOCATION.
0449  1233              ;
0450  1233  78          OFFREP SEI              ;DISABLE INTERRUPTS
0451  1234  A5 61       LDA IRQSAV      ;RESET SAVED IRQ
0452  1236  85 90       STA IRQLO
0453  1238  A5 62       LDA IRQSAV+1
0454  123A  85 91       STA IRQHI
0455  123C  58          CLI             ;RE-ENABLE INTERRUPTS
0456  123D  60          RTS
0457  123E              ;
0458  123E  A5 97       REPEAT LDA KEY          ;GET LAST KEY
0459  1240  C5 5F       CMP SAVCHR      ;SAME AS LAST TIME ?
0460  1242  F0 0D       BEQ REP100      ;YES
0461  1244  85 5F       STA SAVCHR      ;NO - SAVE NEW CHAR.
0462  1246  A9 10       LDA #$10        ;INITIALISE DELAY
0463  1248  85 5E       STA RDELAY
0464  124A  A9 04       LDA #$04        ;INITIALISE REPEAT DELAY
0465  124C  85 60       STA REPDY
0466  124E              ;
0467  124E  6C 61 00    REPEXT JMP (IRQSAV)
0468  1251              ;
0469  1251  C9 FF       REP100 CMP #$FF         ;NO KEY ?
0470  1253  F0 F9       BEQ REPEXT      ;YES - NO MORE
0471  1255  A5 5E       LDA RDELAY      ;TIME TO REPEAT ?
0472  1257  F0 04       BEQ REP200      ;YES - DO IT
0473  1259  C6 5E       DEC RDELAY      ;ELSE DECREMENT DELAY
0474  125B  D0 F1       BNE REPEXT      ;AND EXIT
0475  125D              ;
0476  125D  C6 60       REP200 DEC REPDY        ;BETWEEN REPEAT READY ?
0477  125F  D0 ED       BNE REPEXT      ;NO - EXIT
0478  1261  A9 03       LDA #$03        ;YES - RESET DELAY
0479  1263  85 60       STA REPDY
0480  1265  A9 00       LDA #$00        ;SET NO KEY
0481  1267  85 97       STA KEY         ;FOR REPEAT
0482  1269  F0 E3       BEQ REPEXT      ;AND EXIT
0483  126B              ;
0484  126B              ;WORK OUT ADDRESS OF START OF TEXT
0485  126B              ;LINE INTO PTR2,PTR2+1
0486  126B              ; = TEXT + LINE * TXTWID
0487  126B              ;
0488  126B  A9 89       CALC    LDA #<TEXT      ;SET PTR2 TO TEXT ADDRESS
0489  126D  85 68       STA PTR2
0490  126F  A9 12       LDA #>TEXT
0491  1271  85 69       STA PTR2+1
0492  1273  A6 23       LDX LINE        ;SET COUNTER TO LINE
0493  1275  4C 86 12    JMP CALC20      ;AND SEE IF DONE
0494  1278              ;
0495  1278  18          CALC10 CLC              ;ADD TEXTWIDTH TO RESULT
```

```
HOPE1.S......PAGE 0010

LINE# LOC   CODE        LINE

0496  1279  A5 68             LDA PTR2
0497  127B  69 84             ADC #TXTWID
0498  127D  85 68             STA PTR2
0499  127F  A5 69             LDA PTR2+1
0500  1281  69 00             ADC #0
0501  1283  85 69             STA PTR2+1
0502  1285  CA                DEX              ;DECREMENT COUNTER
0503  1286  D0 F0       CALC20 BNE CALC10       ;IF NOT ZERO - DO MORE
0504  1288               ;
0505  1288  60           CALC30 RTS              ;RETURN
0506  1289               ;
0507  1289               TEXT   =*               ;TEXT STARTS HERE !
0508  1289               ;
0509  1289                      .END

ERRORS = 0000

SYMBOL TABLE

SYMBOL VALUE
 BEG10    1093    BEGIN    108D    BLHC     8780    CALC     126B
 CALC10   1278    CALC20   1286    CALC30   1288    CLRT10   1039
 CLRTXT   102B    DEL      1189    DEL10    1195    DEL20    11AD
 DEL5     1190    DELAY    00F4    DISP10   1064    DISP20   1066
 DISP99   108C    DN       1113    DN10     111C    DN20     1122
 DN30     1134    FLIP     121F    GET      FFE4    GOT10    10EB
 GOT20    110F    GOT30    1148    GOT40    117D    GOT43    1185
 GOT46    11B4    GOT5     10D5    GOT50    11D6    GOT60    11F7
 GOT7     10E0    GOTONE   10A5    HM       11DA    INCPT1   1218
 INS      11B8    INS10    11BD    INS20    11CD    INS5     11BB
 IRQHI    0091    IRQLO    0090    IRQSAV   0061    KEY      0097
 LF       10EF    LF10     1108    LF5      10FA    LINE     0023
 LOC      0024    MAIN     1051    MAXLIN   0027    NOINC1   121E
 OFFREP   1233    ONREP    1228    OUT10    1201    OUT20    120A
 POSNSC   0001    POSNTX   0000    PRT      FFD2    PTR1     0066
 PTR2     0068    PTR3     006A    RDELAY   005E    REP100   1251
 REP200   125D    REPDY    0060    REPEAT   123E    REPEXT   124E
 RT       10B1    RT10     10CE    RT5      10C0    RVSFLG   009F
 SAVCHR   005F    SCREEN   8000    SCRLIN   0002    SCRSIZ   0050
 START    1000    TEXT     1289    TIMER    008F    TXTEND   0034
 TXTWID   0084    UNDCSR   0026    UP       114C    UP10     1150
 UP20     1157    UP30     1169    WAIT     109A
END OF ASSEMBLY
```

# Interrupt on the Commodore PET

## Brad Templeton

One of the most important features of the COMMODORE PET operating system is the use of interrupts. They are used to reset the PET, and they handle most of the tape and all of the keyboard i/o. This article will provide an introduction to interrupts on the 6502 (The PET's cpu) and a description of how the PET handles them. For your information, pseudo source listing is provided for the interrupt software of the PET, as produced by my disassembler.

Under normal conditions a processor executes machine code in a linear fashion. It moves through memory, obtaining instructions (which can be one, two or three bytes long) and executing them. Sometimes, certain programmed instructions cause jumps to other places, just like GOTO and GOSUB of BASIC. To make a machine more flexible, however, interrupts are provided to do jobs that would be very expensive to do in Software.

Essentially, an interrupt is controlled by a line right into the processor. When the processor detects the correct voltage on this line, an interrupt may be generated. First, in order to simplify matters, the processor finishes the instruction it is presently carrying out. Then, if the interrupt is ok (interrupts can be masked), the processor saves the program location it was at, and the contents of its flags onto the stack. It then goes to a special reserved area of memory (in ROM on the PET) and pulls out two bytes indicating what location it should start executing from. It then goes there and executes machine code until the instruction RTI (Return from Interrupt $40) is encountered. It then goes back to the stack and restores its flags, and loads the location it saved to the instruction counter. It then goes and executes the code after where it stopped as though nothing has occurred. (If the interrupt program was correctly written).

On the 6502, three types of hardware interrupts can occur, as well as a fourth special type. The locations they branch to are kept in byte pairs called vectors at the end of memory. One of these interrupts, NMI or Non Maskable Interrupt, cannot be used on the PET. Its Vector, $FFFA-B, points to $CA60, which is the middle of a subroutine. The line for this is also fixed off by a resistor on the PC board. Later PETs may plan to include this.

The interrupt called for power up is named RES. It branches to a routine which sets up basic and the operating system. It also, through what I consider to be one of the PET's worst design flaws, branches to the routine to destructively test how much memory is in the machine. At the very start, it also tests the condition of the diagnostic sense (MSB of $E810) and goes to the diagnostic routine if this is set. RFS is fired by power up, or by grounding pin 27 on the botton of your memory expansion bus. If you set it by touching that pin, it does not clear memory below $400. So programs there (the tape buffers) are safe. This is, unfortunately, a very small area. It vectors through $FFFC-D.

The general use, hardware interrupts is the IRQ. IRQ vectors through $FFFE-F, as does BRK. This points to location $E66B in the PET. It is generated every 60th of a second by the tv hardware, on pin 28. It is also connected to the 6522 versatile interface adaptor. I will discuss the 60 per second interrupts here in detail. For information of generation by the 6522 (there is another whole article's worth of material in there) you can see "The User Port Cookbook" (1). Interrupts can be generated from it at exactly timed intervals, and by certain i/o conditions on the user port and IEEE bus. The exactly timed intervals are used to send precise frequency signals to the tape. (In fact, the 6522 is the PET's tape interface!)

The 60 per second interrupts do the following:

Scan the keyboard, checking for new keys and decoding them.
Increment the real time clock, and check for midnight.
Flash the cursor if it is on ($0224 = 0).
Test tape recorded status for stop-start.
Copy a byte for the break key test.
Whatever else you want them to do.

When the IRQ occurs, the code at $E668 (see source) saves the processor register A, X and Y on the stack. It then checks, by loading back from the stack, the flags, to see if the BRK flag was set. The BRK, a software IRQ, vectors through the same place, but sets the BRK flag. This is handy to test what type of interrupt occurred. It then does a jump indirect to one of two places in RAM ($219 or $218) depending on the type of interrupt.

Normally, the RAM IRQ vector is set to $F685, which is the standard IRQ code. BRK has no default setting. The small piece of code you see after the JMP indirects is the return code, which restores the registers and does the RTI. The first thing INT-CODE does is the JSR INCR-CLOCK which increments the clock and copies the PIA register which the STOP key test uses. When Steve Punter of Mississausa saw this with the disassembler, he devised an ingenious way to disable the BREAK key of the PET. By telling the PET to branch to $E688 instead of $E685 by means of a POKE 537, 136 statement, the PET bypasses the INCR-CLOCK subroutine, and does not test

the break key. (Note INCR-CLOCK passes through a JMP vector table in high ROM at $FFEA). This has the side effect of turning off the real time clock. When this statement is not used the clock proceeds normally. After it is updated, it is compared with a three byte table that contains the value for midnight. If it is midnight on the clock, it is zeroed. The PET also keeps a secondary clock just after the main one. This is used for calibrating the real time clock. About every 6 seconds, this clock reaches a special limit, and when it does, it is zeroed, and the main clock is not incremented on this cycle. This is because the interrupt generator runs slightly faster than exactly 60 times per second. Even with this compensation, you may have noticed the clock is a few seconds off after several hours of PET operation. If they had used the 60 hz ac power line for the interrupt, it would have been more accurate, but that would have caused problems for PETs sold abroad.

After doing the clock, it proceeds to flash the cursor, once every third of a second, if the location FLASHING ($224) is set to zero. (POKE 548,0 in a program turns the cursor on, but with some bugs - try it and see). It does it with a very silly method that has no purpose, instead of the standard method, a $80. It then sets up two keyboard test locations.

In using your PET, you may have noticed that if the tape drive is stopped by the machine itself, that you can push stop and play and the motor will run again. After this comes the keyvoard interpretation routines. The method of decoding the keyboard PIA has already been published in your PET manual, and in PET user notes so I will not dwell on it here. Once it has the matrix co-ordinate of the key, it waits for it to stabilize, to avoid bounce and repeating letters. (The TRS-80 does this poorly). It then converts the matrix number to an ascii character through the table at $E75C. (You can see this table in your programs. If you want to account for how long a key is held down - a great real time feature!) It then outs the key in the correct place in the keyboard buffer starting at $20F. Finally it goes back.

# What Can You Do?

Because the PET IRQ goes through RAM, it is one of the main links you have that can give you operating system control. You can insert your own programs before and after the interrupt code to have your PET do two jobs at once, like handle i/o while running BASIC. I have used interrupts to write programs to:

Interrupt the PET keyboard and the full sized keyboard I attached to the PET like a regular keyboard.
Provide functions like repeat after a certain period of time and shift lock.
Turn the ! key to a statement number key, so that it would provide a line number 10 higher with every push.
Have upper case letter keys print out as full BASIC keywords.
Display whole pages of PET memory constantly on the screen.
Provide a non-destructive reset that works in special cases.
Much more is possible.

To use your own programs, you merely set them up in some convenient location (machine code only), preferably starting at location that ends in $85 (BASIC2: $2E), such as $0385 in the second tape buffer (Uses 1st cassette buffer in BASIC2: $032E) . Something located there can then be started with a POKE 538,3 and stopped with POKE 538,230 (BASIC2: Start with POKE145,3 and stop with POKE145,230), rather than having to write a special machine language program that disables the interrupt with SEI, changes the locations and enables the interrupt with CLI. You do not need to disable if you are only changing one byte of the location. Put some code there and follow it with a JMP $E685 (BASIC2: $E62E). This way it does your code and proceeds on to do its own. If you put in the following series:-

```
BASIC1:
 0385  FE 50 80 4C 85 E6

BASIC2:
 032E  FE 50 80 4C 2E E6
```

and initiate it with POKE 538,3 (BASIC2: POKE 145,3), you will see a byte on the screen constantly increasing in 'value' once every 60th of a second. The PET will also be doing everything else as usual. The following code:

```
BASIC1:
 0385  A2 00 BD 00 00 9D 50 80
 038D  E8 D0 F7 4C 85 E6 00 00

BASIC2:
 032E  A2 00 BD 00 00 9D 50 80
 0336  E8 D0 F7 4C 2E E6 00 00
```

will dump a page of memory on the screen constantly. You can POKE 905 (BASIC2: POKE 818) with the page you wish to examine. Try 0,1,2,3,4,31,232. It starts with page 0. When scanning page 0 move the cursor and see what happens.

While doing this, you may have noticed that there is no flicker whatsoever on the screen despite the massive amount of writing to it being done. (Far faster than BASIC printing). This is because the interrupt is fired by the screen scan signal and the screen is doing nothing shortly after the interrupt goes. This is also why the flashing cursor will never "snow" the screen. You can store almost half a screen without "snow" this way.

Sometimes it is important to put code in after the interrupt code of the PET.

This can be done by manipulation of the stack, and is necessary for programs like the statement numberer or keyboard I included in my list above.

It should be noted that probably the only reason the IRQ vector is in RAM is that the PET does change it for tape I/O routines. There is a table of possible vectors starting at $FD28 in the ROM, and the table ends with the standard vector $E685. If you ever change the high order byte of the IRQ RAM vector, you must reset it before tape I/O is done. If you don't, the PET will reset it anyway, but the tape I/O may not be done, and you may crash your PET.

# Notes for BASIC2 PETs

## H.A.E. Broomhall

These notes are intended to be read with the article by Brad Templeton. They detail the differences of the BASIC2 PET from the BASIC1.

NMI

This can now be used. The vector points to $FCFE. At this address is a single instruction JMP ($0094). This is a 'JUMP indirect' instruction, and uses as the target address a 16 bit address located in $94 (low byte) and $95 (high byte). On power up this is set to $C389, which is the entry to BASIC in command mode, and gives the familiar 'READY' prompt and the cursor.

The importance of NMI is due to the high priority given to it by the 6502. The micro will react to NMI even during an ordinary interrupt (called by IRQ), and also during a 'hangup' in a machine code routine. In the mode to which it is set by power-up, the return to BASIC jump will not always clear a 'hang', as other memory locations may not be as the PET expects! NMI is most useful when the PET is used to control external devices in a multiple interrupt situation.

RES

The only difference here is that the diagnostic routines have been removed, and the diagnostic jumper causes an entry to the machine language monitor, which is resident in the MkII PETs. This fact is the basis of a 'decrash' device available from some outlets.

IRQ

The start of the IRQ routine in MkII PETs is at $E61B. The routine is broadly similar to that in MkI PETs. The main differences in layout are:-

The exit routine 'RETURN-INT' occurs at the end of the 'INT-CODE' section (addr $E6E4).

The subroutine 'DECODE-KBD' is incorporated into 'INT-CODE'.

The main differences in detail:-
IRQ vector address:- $90,$91
BRK vector address:- $92,$93
IRQ vector normaly points to $E62E

To stop clock and 'BREAK' test:- POKE144,49
To reset to normal:- POKE144,46

Cursor flash flag (was $0224) is at $A7. The flashing cursor routine is no longer silly (someone must have read the article!); EOR #$80 is used.

The keyboard matrix to ASCII conversion table is now at $E6F8. The keyboard buffer now at $026F.

# Harry Broomhall — Disk Wizard

Volume 2 Issue 8 was brought out with a great deal of help from Harry Broomhall who has a program called LAZARUS, which can bring a disk which is apparently dead, back to life. The various Commodore centres around the world each produce their own Newletters and information is passed freely amongst the Editors. In Issue 2.8 many of the articles came from the Canadian newsletter 'The Transactor'. Karl Hildon the Editor, sent me the Transactor on disk but the disk had been corrupted by allowing DOS2.1 to write to a DOS1 disk which is a no-no! Harry put the disk right by feeding it to Lazarus. The program can not work miracles however, some disks are just too far gone! If you have a disk which contains valuable data and it has been corrupted in some manner, Harry can put it right for you. The cost for this is £15Ø if he can get the disk working again. Contact Harry Broomhall at Heronview Ltd., 3 Errol St., London EC1.

# BASIC2/BASIC4 ROM Comparison

## BASIC2.0 and BASIC4.0 ROM Memory Maps

Entry points comparison for BASIC 2.0 and BASIC 4.0 based on Memory maps supplied by Jim Butterfield, compilation into 1 table by Dave Briggs.

This map shows where various routines lie. The first address is not necessarily the proper entry point for the routine. Similarly, many routines require register setup or data preparation before calling.

| BASIC 2.0 | BASIC 4.0 | Description |
|---|---|---|
| C000-C045 | B000-B065 | Action addresses for primary keywords |
| C046-C073 | B066-B093 | Action addresses for functions |
| C074-C091 | B094-B0B1 | Hierarchy and action addresses for operators |
| C092-C192 | B0B2-B20C | Table of Basic keywords |
| C193-C2A9 | B20D-B321 | Basic messages, mostly error messages |
| C2AA-C2D7 | B322-B34F | Search the stack for FOR or GOSUB activity |
| C2D8-C31A | B350-B392 | Open up space in memory |
| C31B-C327 | B393-B39F | Test: stack too deep? |
| C328-C354 | B3A0-B3CC | Check available memory |
| C355 | B3CD | Send canned error message, then: |
| C389-C3AA | B3FF-B41E | Warm start; wait for Basic command |
| C3AB-C441 | B41F-B4B5 | Handle new Basic line input |
| C442-C46E | B4B6-B4E1 | Rebuild chaining of Basic lines |
| C46F-C494 | B4E2-B4FA | Receive line from keyboard |
| C495-C52B | B4FB-B5A2 | Crunch keywords into Basic tokens |
| C52C-C55A | B5A3-B5D1 | Search Basic for given line number |
| C55B | B5D2 | Perform NEW, and; |
| C577-C5A6 | B5EC-B621 | Perform CLR |
| C5A7-C5BA | B622-B62F | Reset Basic execution to start |
| C5B5-C657 | B630-B6DD | Perform LIST |
| C658-C6FF | B6DE-B784 | Perform FOR |
| C700-C72F | B785-B7B6 | Execute Basic statement |
| C730-C73E | B7B7-B7C5 | Perform RESTORE |
| C73F-C76A | B7C6-B7ED | Perform STOP or END |
| C76B-C784 | B7EE-B807 | Perform CONT |
| C785-C78F | B808-B812 | Perform RUN |
| C790-C7AC | B813-B839 | Perform GOSUB |
| C7AD-C7D9 | B830-B85C | Perform GOTO |
| C7DA | B85D | Perform RETURN, then: |
| C7F3-C80D | B883-B890 | Perform DATA: skip statement |
| C80E-C810 | B891-B893 | Scan for next Basic statement |
| C811-C82F | B894-B8B2 | Scan for next Basic line |
| C830 | B8B3 | Perform IF, and perhaps: |
| C843-C852 | B8C6-B8D5 | Perform REM: skip line |
| C853-C872 | B8D6-B8F5 | Perform ON |
| C873-C8AC | B8F6-B92F | Accept fixed-point number |
| C8AD-C927 | B930-BA87 | Perform LET |
| C98B-C990 | BA88-BA8D | Perform PRINT# |
| C991-C9A4 | BA8E-BAA1 | Perform CMD |
| C9A5-CA1B | BAA2-BB1C | Perform PRINT |
| CA1C-CA38 | BB1D-BB39 | Print string from memory |
| CA39-CA4E | BB3A-BB4B | Print single format character |
| CA4F-CA7C | BB4C-BB79 | Handle bad input data |
| CA7D-CAA6 | BB7A-BBA3 | Perform GET |
| CAA7-CAC0 | BBA4-BBBD | Perform INPUT# |
| CAC1-CAF9 | BBBE-BBF4 | Perform INPUT |
| CAFA-CB06 | BBF5-BC01 | Prompt and receive input |
| CB07-CBFB | BC02-BCF6 | Perform READ |
| CBFC-CC1F | BCF7-BD18 | Canned Input error messages |
| CC20-CC78 | BD19-BD71 | Perform NEXT |
| CC79-CC9E | BD72-BD97 | Check type mismatch |
| CC9F-CDEB | BD98-BEE8 | Evaluate expression |
| CDEC-CDF1 | BEE9-BEEE | Evaluate expression within parentheses |
| CDF2-CE02 | BEEF-EEEF | Check parenthesis, comma |
| CE03-CE07 | BF00-BF0B | Syntax error exit |
| CE0F-CE88 | BF8C-C046 | Variable name setup |
| CE08-CE0E | C047-C085 | Set up function references |
| CEC8-CEF7 | C086-C0B5 | Perform OR, AND |
| CEF8-CF5F | C0B6-C11D | Perform comparisons |
| CF60-CF6C | C11E-C12A | Perform DIM |
| CF6D-CFF6 | C12B-C1BF | Search for variable |
| D001-D077 | C1C0-C2C7 | Create new variable |
| D078-D088 | C2C8-C2D8 | Setup array pointer |
| D089-D08C | C2D9-C2DC | 32768 in floating binary |
| D08D-D0AB | C2DD-C2FB | Evaluate integer expression |
| D0AC-D227 | C2FC-C447 | Find or make array |
| D228-D258 | C477-CA47 | Compute array subscript size |
| D259 | C4A8 | Perform FRE, and: |
| D26D-D279 | C4BC-C4C8 | Convert fixed-to-floating |
| D27A-D27F | C4C9-C4CE | Perform POS |
| D280-D28C | C4CF-C4DB | Check not Direct |
| D28D-D2BA | C4DC-C509 | Perform DEF |
| D2BB-D2CD | C50A-C51C | Check FNx syntax |
| D2CE-D33E | C51D-C58D | Evaluate FNx |
| D33F-D34E | C58E-C59D | Perform STR$ |
| D34F-D360 | C59E-C5AF | Do string vector |
| D361-D3CD | C5B0-C61C | Scan, set up string |
| D3CE-D3FF | C61D-C669 | Allocate space for string |
| D400-D496 | C66A-C74E | Garbage collection |
| D517-D553 | C74F-C78B | Concatenate |
| D554-D57C | C78C-C7B4 | Store string |
| D57D-D5B4 | C7B5-C810 | Discard unwanted string |
| D5B5-D5C5 | C811-C821 | Clean descriptor stack |
| D5C6-D5D9 | C822-C835 | Perform CHR$ |
| D5DA-D605 | C836-C861 | Perform LEFT$ |
| D606-D610 | C862-C86C | Perform RIGHT$ |
| D611-D63A | C86D-C896 | Perform MID$ |
| D63B-D655 | C897-C8B1 | Pull string data |
| D656-D65B | C8B2-C8B7 | Perform LEN |
| D65C-D664 | C8B8-C8C0 | Switch string to numeric |
| D665-D674 | C8C1-C8D0 | Perform ASC |
| D675-D686 | C8D1-C8E2 | Get byte parameter |
| D687-D6C5 | C8E3-C920 | Perform VAL |
| D6C6-D6D1 | C921-C92C | Get two parameters for POKE or WAIT |
| D6D2-D6E7 | C92D-C942 | Convert floating-to-fixed |
| D6E8-D706 | C943-C959 | Perform PEEK |
| D707-D70F | C95A-C962 | Perform POKE |
| D710-D72B | C963-C97E | Perform WAIT |
| D72C-D732 | C97F-C985 | Add 0.5 to accumulator #1 |
| D733-D744 | C986-C997 | Perform subtraction |
| D76E-D852 | C998-CA7C | Perform addition |
| D853-D889 | CA7D-CAB3 | Complement accum#1 |
| D88A-D88E | CAB4-CAB8 | Overflow exit |
| D88F-D8C7 | CAB9-CAF1 | Multiply-a-byte |
| D8C8-D8F5 | CAF2-CB1F | Constants |
| D8F6-D936 | CB20-CB5D | Perform LOG |
| D937-D964 | CB5E-CBC1 | Perform multiplication |
| D998-D9C2 | CBC2-CBEC | Unpack memory into accum#2 |
| D9C3-D9DF | CBED-CC09 | Test & adjust accumulators |
| D9E0-D9ED | CC0A-CC17 | Handle overflow and underflow |
| D9EE-DA04 | CC18-CC2E | Multiply by 10 |
| DA05-DA09 | CC2F-CC33 | 10 in floating binary |
| DA0A-DA12 | CC34-CC3C | Divide by 10 |
| DA1E-DAAD | CC3D-CC44 | Perform divide-by |
| DA13-DA1D | CC45-CCD7 | Perform divide-into |
| DAAE-DAD2 | CCD8-CCFC | Unpack memory into accum#1 |
| DAD3-DB07 | CCFD-CD31 | Pack accum#1 into memory |
| DB08-DB17 | CD32-CD41 | Move accum#2 to #1 |
| DB18-DB26 | CD42-CD50 | Move accum#1 to #2 |
| DB27-DB36 | CD51-CD60 | Round accum#1 |
| DB37-DB44 | CD61-CD6E | Get accum#1 sign |
| DB45-DB63 | CD6F-CD8D | Perform SGN |
| DB64-DB66 | CD8E-CD90 | Perform ABS |
| DB67-DBA6 | CD91-CDD0 | Compare accum#1 to memory |
| DBA7-DBD7 | CDD1-CE01 | Floating-to-fixed |
| DBD8-DBFE | CE02-CE28 | Perform INT |
| DBFF-DC89 | CE29-CEB3 | Convert string to floating-point |
| DC8A-DCBE | CEB4-CEE8 | Get new ASCII digit |
| DCBF-DCCD | CEE9-CEF8 | Constants |
| DCCE | CF78 | Print IN, then: |
| DCD9-DCE8 | CF7F-CF92 | Print Basic line # |
| DCE9-DE1C | CF93-D0C6 | Convert floating-point to ASCII |
| DE1D-DE5D | D0C7-D107 | Constants |
| DE5E-DE67 | D108-D111 | Perform SQR |
| DE68-DEA0 | D112-D14A | Perform power function |
| DEA1-DEAB | D14B-D155 | Perform negation |
| DEAC-DED9 | D156-D183 | Constants |
| DEDA-DF2C | D184-D1D6 | Perform EXP |
| DF2D-DF76 | D1D7-D220 | Series evaluation |
| DF77-DF7E | D221-D228 | RND constants |
| DF7F-DFD7 | D229-D281 | Perform RND |
| DFD8-DFDE | D282 D288 | Perform COS |
| DFDF-E027 | D289-D2D1 | Perform SIN |
| E028-E053 | D2D2-D2FD | Perform TAN |
| E054-E08D | D2FE-D32B | Constants |
| E08C-E0BB | D32C-D35B | Perform ATN |
| E0BC-E0F8 | D35C-D398 | Constants |
| E0F9-E110 | D399-D3B5 | CHRGET sub for zero page |
| E116-E1B6 | D3B6-D471 | Basic cold start |
| E1B7-E1DD | D448-D471 | Messages, BYTES FREE, ### COMMODORE BASIC ### |
| | D7AC-D802 | Perform RECORD |
| | D803-D837 | Disk parameter checks |
| | D838-D872 | Dummy disk control messages |
| | D873-D919 | Perform CATALOG or DIRECTORY |
| | D91A-D92E | Output |

```
          D92F-D941 Find spare secondary address
          D942-D976 Perform DOPEN
          D977-D990 Perform APPEND
          D991-D9D1 Get disk status
          D9D2-DA06 Perform HEADER
          DA07-DA30 Perform DCLOSE
          DA31-DA64 Set up disk record
          DA65-DA7D Perform COLLECT
          DA7E-DAA6 Perform BACKUP
          DAA7-DAC6 Perform COPY
          DAC7-DAD3 Perform CONCAT
          DAD4-DB0C Insert command string values
          DB0D-DB39 Perform DSAVE
          DB3A-DB65 Perform DLOAD
          DB66-DB98 Perform SCRATCH
          DB99-DB9D Check Direct command
          DB9E-DBD6 Query ARE YOU SURE?
          DBD7-DBE0 Print BAD DISK
          DBE1-DBF9 Clear DS$ and ST
          DBFA-DC67 Assemble disk command string
          DC68-DE29 Parse Basic DOS command
          DE2C-DE48 Get Device number
          DE49-DE86 Get File name
          DE87-DE9C Get small variable parameter

** Entry points only for E000-E7FF **
E1DE      E000      Register/screen initialization
E285      E0A7      Input from keyboard
E2F2      E116      Input from screen
E3D8      E202      Output character
E61B      E442      Main interrupt entry
E62E      E455      Interrupt: clock, cursor, keyboard
E6E4      E600      Exit from Interrupt
**                              **
E76A-E7FF D717-D7AB MLM subroutines
**                              **
F000-F0B5 F000-F0D1 File messages
F0B6-F0B9 F0D2-F0D4 Send 'Talk'
F0BA-F0BB F0D5-F0D6 Send 'Listen'
F0BC-F0ED F0D7-F108 Send IEEE command character
F0EE-F127 F109-F142 Send byte to IEEE
F128-F135 F143-F150 Send byte and clear ATN
          F151-F16B Option: timeout or wait
F136-F13F F16C-F16F DEVICE NOT PRESENT
F140-F155 F170-F184 Timeout on read, clear control lines
F156-F163 F185-F192 Send canned file message
F164-F16E F193-F19D Send byte, clear control lines
F16F-F17E F19E-F1AD Send normal (deferred) IEEE char
F17F-F18B F1AE-F1BF Drop IEEE device
F18C-F1D0 F1C0-F204 Input byte from IEEE
F1D1-F1E0 F205-F214 GET a byte
F1E1-F231 F215-F265 INPUT a byte
F232-F26D F266-F2A1 Output a byte
F26E-F283 F2A2-F2B5 Abort files
F284-F28C F2B6-F2C0 Restore default I/O devices
F28D-F2A8 F2C1-F2DC Find/setup file data
F2A9-F300 F2DD-F334 Perform CLOSE
F301-F30E F335-F342 Test STOP key
F30F-F314 F343-F348 Action STOP key
F315-F31C F349-F350 Send message if Direct mode
F31D-F321 F351-F355 Test if Direct mode
F322-F3C1 F356-F400 Program load subroutine
F3C2-F409 F401-F448 Perform LOAD
F40A-F42D F449-F46C Print SEARCHING
F42E-F43D F46D-F47C Print LOADING or VERIFYING
F43E-F45F F47D-F4A4 Get Load/Save parameters
F466-F493 F4A5-F4D2 Send name to IEEE
F494-F4B6 F4D3-F4F5 Find specific tape header
F4B7-F4CD F4F6-F50C Perform VERIFY
F4CE-F50D F50D-F55F Get Open/Close parameters
F521-F5A5 F560-F5E4 Perform OPEN
F5A6-F5D9 F5E5-F618 Find any tape header
F5DA-F63B F619-F67A Write tape header
F63C-F655 F67B-F694 Get start/end addrs from header
F656-F66B F695-F6AA Set buffer address
F66C-F683 F6AB-F6C2 Set buffer start & end addrs
F684-F68C F6C3-F6CB Perform SYS
F68D-F69D F6CC-F6DC Set tape write start & end
F69E-F728 F6DD-F767 Perform SAVE
F729-F76F F768-F7AE Update clock
F770-F7BB F7AF-F7FD Connect input device
F7BC-F805 F7FE-F84A Connect output device
F806-F811 F84B-F856 Bump tape buffer pointer
F812-F834 F857-F879 Wait for PLAY
F835-F846 F87A-F88B Test cassette switch
F847-F854 F88C-F899 Wait for RECORD
F855-F885 F89A-F8CA Initiate tape read
F886-F89A F8CB-F8DF Initiate tape write
F89B-F8E5 F8E0-F92A Common tape I/O
F8E6-F8EF F92B-F934 Test I/0 complete
F8F0-F8FF F935-F944 Test STOP key
F900-F930 F945-F975 Tape bit timing adjust
F931-FA56 F976-FA9B Read tape bits
FA57-FB75 FA9C-FBBA Read tape characters
FB76-FB7E FBBB-FBC3 Reset tape read address
FB7F-FB83 FBC4-FBC8 Flag error into ST
FB84-FB92 FBC9-FBD7 Reset counters for new byte
FB93-FBAE FBD8-FBF3 Write a bit to tape
FBAF-FC40 FBF4-FC85 Tape write
FC41-FC7A FC86-FCBF Write tape leader
FC7B-FC95 FCC0-FCDA Terminate tape; restore interrupt
FC96-FCA5 FCDB-FCEA Set interrupt vector
FCA6-FCB3 FCEB-FCF8 Turn off tape motor
FCB4-FCC5 FCF9-FD0A Checksum calculation
FCC6-FCD0 FD0B-FD15 Advance load/save pointer
FCD1-FCFD FD16-FD4B Power-on Reset
FD01-FD10 FD4C-FD5C Table of interrupt vectors
FD11-FFB0 D472-D716 Machine Language Monitor
** Jump table:                 **
          FF93-FF9E CONCAT,DOPEN,DCLOSE,RECORD
          FF9F-FFAA HEADER,COLLECT,BACKUP,COPY
          FFAB-FFB6 APPEND,DSAVE,DLOAD,CATALOG
          FFB7-FFBC RENAME,SCRATCH
          FFBD      Get disk status
FFC0      FFC0      OPEN
FFC3      FFC3      CLOSE
FFC6      FFC6      Set input device
FFC9      FFC9      Set output device
FFCC      FFCC      Restore default I/O devices
FFCF      FFCF      INPUT a byte
FFD2      FFD2      Output a byte
FFD5      FFD5      LOAD
FFD8      FFD8      SAVE
FFDB      FFDB      VERIFY
FFDE      FFDE      SYS
FFE1      FFE1      Test stop key
FFE4      FFE4      GET byte
FFE7      FFE7      Abort all files
FFEA      FFEA      Update clock
FFFA-FFFF FFFA-FFFF Hard vectors:  NMI, Reset, INT
```

# BASIC 4.0 Memory Map

Compiled by Jim Butterfield

There are some differences between usage between the 40- and 80-column machines.

| Hex | Decimal | Description |
|---|---|---|
| 0000-0002 | 0-2 | USR jump |
| 0003 | 3 | Search character |
| 0004 | 4 | Scan-between-quotes flag |
| 0005 | 5 | Input buffer pointer; # of subscripts |
| 0006 | 6 | Default DIM flag |
| 0007 | 7 | Type: FF=string, 00=numeric |
| 0008 | 8 | Type: 80=integer, 00=floating point |
| 0009 | 9 | Flag: DATA scan; LIST quote; memory |
| 000A | 10 | Subscript flag; FNX flag |
| 000B | 11 | 0=INPUT; $40=GET; $98=READ |
| 000C | 12 | ATN sign/Comparison Evaluation flag |
| 000D-000F | 13-15 | Disk status DS$ descriptor |
| 0010 | 16 | Current I/O device for prompt-suppress |
| 0011-0012 | 17-18 | Integer value (for SYS, GOTO etc) |
| 0013-0015 | 19-21 | Pointers for descriptor stack |
| 0016-001E | 22-30 | Descriptor stack(temp strings) |
| 001F-0022 | 31-34 | Utility pointer area |
| 0023-0027 | 35-39 | Product area for multiplication |
| 0028-0029 | 40-41 | Pointer: Start-of-Basic |
| 002A-002B | 42-43 | Pointer: Start-of-Variables |
| 002C-002D | 44-45 | Pointer: Start-of-Arrays |
| 002E-002F | 46-47 | Pointer: End-of-Arrays |
| 0030-0031 | 48-49 | Pointer: String-storage(moving down) |
| 0032-0033 | 50-51 | Utility string pointer |
| 0034-0035 | 52-53 | Pointer: Limit-of-memory |
| 0036-0037 | 54-55 | Current Basic line number |
| 0038-0039 | 56-57 | Previous Basic line number |
| 003A-003B | 58-59 | Pointer: Basic statement for CONT |
| 003C-003D | 60-61 | Current DATA line number |
| 003E-003F | 62-63 | Current DATA address |
| 0040-0041 | 64-65 | Input vector |
| 0042-0043 | 66-67 | Current variable name |
| 0044-0045 | 68-69 | Current variable address |
| 0046-0047 | 70-71 | Variable pointer for FOR/NEXT |
| 0048-0049 | 72-73 | Y-save; op-save; Basic pointer save |
| 004A | 74 | Comparison symbol accumulator |
| 004B-0050 | 75-80 | Misc work area, pointers, etc |
| 0051-0053 | 81-83 | Jump vector for functions |
| 0054-005D | 84-93 | Misc numeric work area |
| 005E | 94 | Accum#1: Exponent |
| 005F-0062 | 95-98 | Accum#1: Mantissa |
| 0063 | 99 | Accum#1: Sign |
| 0064 | 100 | Series evaluation constant pointer |
| 0065 | 101 | Accum#1 hi-order (overflow) |
| 0066-006B | 102-107 | Accum#2: Exponent, etc. |
| 006C | 108 | Sign comparison, Acc#1 vs #2 |
| 006D | 106 | Accum#1 lo-order (rounding) |
| 006E-006F | 110-111 | Cassette buff len/Series pointer |
| 0070-0087 | 112-135 | CHRGET subroutine; get Basic char |
| 0077-0078 | 119-120 | Basic pointer (within subrtn) |
| 0088-008C | 136-140 | Random number seed. |
| 008D-008F | 141-143 | Jiffy clock for TI and TI$ |
| 0090-0091 | 144-145 | Hardware interrupt vector |
| 0092-0093 | 146-147 | BRK interrupt vector |
| 0094-0095 | 148-149 | NMI interrupt vector |
| 0096 | 150 | Status word ST |
| 0097 | 151 | Which key down; 255=no key |
| 0098 | 152 | Shift key: 1 if depressed |
| 0099-009A | 153-154 | Correction clock |
| 009B | 155 | Keyswitch PIA: STOP and RVS flags |
| 009C | 156 | Timing constant for tape |
| 009D | 157 | Load=0, Verify=1 |
| 009E | 158 | Number of characters in keybd buffer |
| 009F | 159 | Screen reverse flag |
| 00A0 | 160 | IEEE output; 255=character pending |
| 00A1 | 161 | End-of-line-for-input pointer |
| 00A3-00A4 | 163-164 | Cursor log (row, column) |
| 00A5 | 165 | IEEE output buffer |

| | | |
|---|---|---|
| 00A6 | 166 | Key image |
| 00A7 | 167 | 0=flash cursor |
| 00A8 | 168 | Cursor timing countdown |
| 00A9 | 169 | Character under cursor |
| 00AA | 170 | Cursor in blink phase |
| 00AB | 171 | EOT received from tape |
| 00AC | 172 | Input from screen/from keyboard |
| 00AD | 173 | X save |
| 00AE | 174 | How many open files |
| 00AF | 175 | Input device, normally 0 |
| 00B0 | 176 | Output CMD device, normally 3 |
| 00B1 | 177 | Tape character parity |
| 00B2 | 178 | Byte received flag |
| 00B3 | 179 | Logical Address temporary save |
| 00B4 | 180 | Tape buffer character; MLM command |
| 00B5 | 181 | File name pointer; MLM flag, counter |
| 00B7 | 183 | Serial bit count |
| 00B9 | 185 | Cycle counter |
| 00BA | 186 | Tape writer countdown |
| 00BB-00BC | 187-188 | Tape buffer pointers, #1 and #2 |
| 00BD | 189 | Write leader count; read pass1/2 |
| 00BE | 190 | Write new byte; read error flag |
| 00BF | 191 | Write start bit; read bit seq error |
| 00C0-00C1 | 192-193 | Error log pointers, pass1/2 |
| 00C2 | 194 | 0=Scan/1-15=Count/$40=Load/$80=End |
| 00C3 | 195 | Write leader length; read checksum |
| 00C4-00C5 | 196-197 | Pointer to screen line |
| 00C6 | 198 | Position of cursor on above line |
| 00C7-00C8 | 199-200 | Utility pointer: tape, scroll |
| 00C9-00CA | 201-202 | Tape end addrs/End of current program |
| 00CB-00CC | 203-204 | Tape timing constants |
| 00CD | 205 | 0=direct cursor, else programmed |
| 00CE | 206 | Tape read timer 1 enabled |
| 00CF | 207 | EOT received from tape |
| 00D0 | 208 | Read character error |
| 00D1 | 209 | # characters in file name |
| 00D2 | 210 | Current file logical address |
| 00D3 | 211 | Current file secondary addrs |
| 00D4 | 212 | Current file device number |
| 00D5 | 213 | Right-hand window or line margin |
| 00D6-00D7 | 214-215 | Pointer: Start of tape buffer |
| 00D8 | 216 | Line where cursor lives |
| 00D9 | 217 | Last key/checksum/misc. |
| 00DA-00DB | 218-219 | File name pointer |
| 00DC | 220 | Number of INSERTs outstanding |
| 00DD | 221 | Write shift word/read character in |
| 00DE | 222 | Tape blocks remaining to write/read |
| 00DF | 223 | Serial word buffer |
| 00E0-00F8 | 224-248 | (40-column) Screen line wrap table |
| 00E0-00E1 | 224-225 | (80-column) Top, bottom of window |
| 00E2 | 226 | (80-column) Left window margin |
| 00E3 | 227 | (80-column) Limit of keybd buffer |
| 00E4 | 228 | (80-column) Key repeat flag |
| 00E5 | 229 | (80-column) Repeat countdown |
| 00E6 | 230 | (80-column) New key marker |
| 00E7 | 231 | (80-column) Chime time |
| 00E8 | 232 | (80-column) HOME count |
| 00E9-00EA | 233-234 | (80-column) Input vector |
| 00EB-00EC | 235-236 | (80-column) Output vector |
| 00F9-00FA | 249-250 | Cassette status, #1 and #2 |
| 00FB-00FC | 251-252 | MLM pointer/Tape start address |
| 00FD-00FE | 253-254 | MLM, DOS pointer, misc. |
| 0100-010A | 256-266 | STR$ work area, MLM work |
| 0100-013E | 256-318 | Tape read error log |
| 0100-01FF | 256-511 | Processor stack |
| 0200-0250 | 512-592 | MLM work area; Input buffer |
| 0251-025A | 593-602 | File logical address table |
| 025B-0264 | 603-612 | File device number table |
| 0265-026E | 613-622 | File secondary adds table |
| 026F-0278 | 623-632 | Keyboard input buffer |
| 027A-0339 | 634-825 | Tape#1 input buffer |
| 033A-03F9 | 826-1017 | Tape#2 input buffer |
| 033A | 826 | DOS character pointer |
| 033B | 827 | DOS drive 1 flag |
| 033C | 828 | DOS drive 2 flag |
| 033D | 829 | DOS length/write flag |
| 033E | 830 | DOS syntax flags |

daisy. The printer can print at speeds of up to 60 characters a second and produces output of great quality, especially if carbon ribbons are used. This newsletter is photographically reproduced from the output of a daisy-wheel printer and readers can compare the text with program listings printed on a dot matrix printer. Having the two printers would provide a backup system in the case of breakdowns, which becomes very attractive if you become, as is highly likely, increasingly reliant on the computer. An alternative is of course to hire a daisy-wheel when required.

People vary in their ability to read computer printout which has been produced on a dot-matrix printer. Some cannot adjust to the fact that the descending parts of letters do not drop below the line. If frequent users of the output suffer from this disability, then you may be forced to pay more for a printer with a more complex matrix head. The point is that the common head is of a design which requires characters to be designed out of 49 dots, arranged in a square, 7 X 7. This forces design compromises. Printers exist which use 9 X 7 or even more complex heads but these are correspondingly more expensive.

We should now consider the question of noise.

It is well worth making sure that the printer which sounds quiet at an exhibition is in fact acceptably quiet in the more peaceful office situation. You should also watch out for the amount of vibration and whether this is likely to cause disturbance. Accoustic covers to reduce noise are well worth considering. Thermal printers are very silent but the output has a tendency to fade when exposed to prolnged sunlight.

To turn to more mundane matters. The choice of appropriate paper should be looked at with some care. Prices for identical paper vary a lot and shopping around can pay handsome dividends. Consider whether you will save valuable time using "one time carbon" or "no carbon required" two, three or four part sets, where multiple copies are required.

It is worth looking at various weights of paper, especially where word processing is involved.

It is possible to use ordinary tractor feed stationery for many purposes, but you may wish to produce a single sheet output for some work. In either case, you should look at the type of paper-feed offered by the printer of your choice, and decide if it fits your requirements. If not, find out how much extra it will cost to have the additional equipment fitted to, for instance, change the friction-fed daisy wheel to a tractor feed.

Surprisingly enough, it is even possible to have separate letter-heads glued to continuous paper, so that standard letters may be produced on a tractor fed printer and then detached this will then be indistinguishable from individual typewritten versions. This method is very expensive however.

It is worth looking at the type of ribbons available also. If you have the choice of fabric and carbon ribbons, you can make much better-looking printing available, when necessary. Some printers will even allow printing in red to occur, controlled by the program!

The conclusion of all this is that as much care should be given to printer selectoion as to the selection of the computer itself. Surveys are published from time to time in the commercial magazines and you should study these in depth. As a last bit of advise make sure you are quoted prices with the printer interface included as this can cost over £100 pounds and ensure that ribbons and service are available.

| | | |
|---|---|---|
| 033F-0340 | 831-832 | DOS disk ID |
| 0341 | 833 | DOS command string count |
| 0342-0352 | 834-850 | DOS file name buffer |
| 0353-0380 | 851-896 | DOS command string buffer |
| 03EE-03F7 | 1006-1015 | (80-column) Tab stop table |
| 03FA-03FB | 1018-1019 | Monitor extension vector |
| 03FC | 1020 | IEEE timeout defeat |
| 0400-7FFF | 1024-32767 | Available RAM including expansion |
| 8000-83FF | 32768-33791 | (40-column) Video RAM |
| 8000-87FF | 32768-34815 | (80-column) Video RAM |
| 9000-AFFF | 36864-45055 | Available ROM expansion area |
| B000-DFFF | 45056-57343 | Basic, DOS, Machine Lang Monitor |
| E000-E7FF | 57344-59391 | Screen, Keyboard, Interrupt programs |
| E810-E813 | 59408-59411 | PIA 1 - Keyboard I/O |
| E820-E823 | 59424-59427 | PIA 2 - IEEE-488 I/O |
| E840-E84F | 59456-59471 | VIA - I/O and timers |
| E880-E881 | 59520-59521 | (80-column) CRT Controller |
| F000-FFFF | 61440-65535 | Reset, I/O handlers, Tape routines |